THE COLLEGE-LEVEL ACADEMIC SKILLS TEST (CLAST) AND COMPUTATIONAL ACHIEVEMENT OF STUDENTS FROM A FLORIDA COMMUNITY COLLEGE

By

ROBERT J. RAPALJE

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Robert J. Repelje

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The Florida College-Level Academic Skills Test (CLAST), a statewide college sophomore testing program designed to upgrade communications and computational skills, has caused concern to students and educators. The purpose of this study was to compare and contrast characteristics of community college students who performed well on CLAST computational skills with students who performed poorly. Four major research questions were addressed and 14 null hypotheses tested to identify significant differences ($p < .05$) between the groups. Of 724 students from one community college who completed the CLAST from spring 1985 through summer 1986, those who scored below the minimum required by the state board and an equal number of the highest scoring students (total n=56) were selected for study. Demographic, academic, and affective variables were investigated. To answer the research questions, students' high school and college academic preparation, standardized test scores, personal interviews, and scores from the

Myers-Briggs Type Indicator, the Mathematics Anxiety Rating Scale, and the Style Delineator were utilized.

Significant differences ($p < .05$) were found for most academic variables, with students in the high scoring group significantly higher for all ACT and SAT placement tests; reading, writing, and essay subtests of CLAST; all high school academic variables including GPA and number of semesters and types of high school mathematics courses; community college GPA; college mathematics GPA; and number of semesters and types of college mathematics courses. High scoring students more frequently had completed a college preparatory curriculum in high school; planned careers in engineering, education, and computers; and showed higher concrete/sequential (learning style) scores and lower levels of mathematics anxiety. Low scoring students more frequently were minority students and first generation college students, had completed a general high school curriculum, planned careers in business, social science, and arts, had withdrawn from more mathematics courses; and showed higher abstract/random (learning style) scores and higher mathematics anxiety.

Recommendations included identifying high-risk students upon entry into the community college; developing additional learning materials and services to emphasize test-taking skills, sequential thinking skills, and time-commitment to homework; and increasing awareness among faculty of student attitudes toward mathematics.

CHAPTER I
THE NATURE OF THE PROBLEM

Introduction

In 1979, the Florida Legislature passed a bill requiring that all public university and community college students demonstrate communications and computations skills before entering the junior year (State Level Task Force, 1980). These skills were formulated by the College-Level Academic Skills Project and assessed by the College-Level Academic Skills Test (CLAST) beginning in the fall of 1982 (College-Level Academic Skills Project, 1984e).

Beginning in 1984, standards were established requiring minimum scores for students to receive the Associate of Arts degree or to be admitted to upper division status in a state university of Florida. These minimum scores increased in July 1986 and were scheduled to increase again in July 1989 (College-Level Academic Skills Project, 1984a). As these standards increase, there is a need to improve the curriculum and to determine strategies that will assist students in meeting the increased standards.

Purpose of the Study

The purpose of this study was to compare and contrast the characteristics of students of a community college who performed well on the computations subtest of the CLAST with students who performed poorly or failed this test. Differences in performance on the computations subtest of the CLAST were related to other factors particular to one community college. Profiles typical of successful and unsuccessful students were drawn from these data.

From these contrasting profiles, factors likely to be correlated with the successful completion of the computational skills of the CLAST were identified. Similarly, academic background, personality type, cognitive style, and attitudes characteristic of students who scored poorly were described. The analysis of these characteristics resulted in a list of factors which could be used in designing a program of studies to help students achieve mathematics skills and perform well on the CLAST. With such a program, school and college teachers could devise interventions to assist future students exhibiting high risk factors and attitudes. These interventions could enable students who might never have attempted the CLAST, because of poor attitudes and high-risk factors, to perform well on this test.

A profile of the high risk student includes low entrance test scores, not only in mathematics, but in other areas as well; a weak high school mathematics background; and a poor self-concept, especially in mathematics. Such students have traditionally avoided mathematics. Much, if not all, of their previous experience in mathematics has been negative, and they exhibit high anxiety and low self-esteem (Futuro & Lang, 1982; Moore, 1970).

Four research questions were addressed in the study, and 14 null hypotheses were tested to identify significant differences ($p < .05$) between high scoring and low scoring groups.

1. What demographic characteristics describe the students from this particular community college who performed very well or very poorly on the computational skills of the CLAST during the 1985-86 school year?

H_1: There are no significant differences in age, sex, race, citizenship, or socioeconomic status between students who performed well and students who performed poorly on the computational skills of the CLAST.

H_2: There are no significant differences in enrollment/employment status, majors, or career plans between students who performed well and students who performed poorly on the computational skills of the CLAST.

2. How do students who performed well on the computational skills of the CLAST compare in performance on other standardized tests with those students who performed poorly?

H_3: There are no significant differences in entrance test scores of the American College Testing (ACT) Program or the Scholastic Aptitude Test (SAT) between students who performed well and students who performed poorly on the computational skills of the CLAST.

H_4: There are no significant differences in performance on the reading, writing, or essay subtests of the CLAST between students who performed well and students who performed poorly on the computational skills of the CLAST.

3. How do students who performed well on the computational skills of the CLAST compare in academic preparation with those students who performed poorly?

H_5: There are no significant differences in high school academic preparation between students who performed well and students who performed poorly on the computational skills of the CLAST.

H_6: There are no significant differences in college academic preparation between students who performed well and students who performed poorly on the computational skills of the CLAST.

H_7: There are no significant differences in college mathematics preparation between students who performed well and students who performed poorly on the computational skills of the CLAST.

H_8. There are no significant differences in preparation for the CLAST or perceived difficulty with the CLAST between students who performed well and students who performed poorly on the computational skills of the CLAST.

4. How do students who performed well on the computational skills of the CLAST compare in affective characteristics with those students who performed poorly?

H_9: There are no significant differences in cognitive styles between students who performed well and students who performed poorly on the computational skills of the CLAST.

H_{10}: There are no significant differences in recall of experiences or role models in mathematics between students who performed well and students who performed poorly on the computational skills of the CLAST.

H_{11}: There are no significant differences in personality types between students who performed well and students who performed poorly on the computational skills of the CLAST.

H_{12}: There are no significant differences in attitudes of students toward mathematics or testing between students who performed well and students who performed poorly on the computational skills of the CLAST.

H_{13}: There are no significant differences in attitudes of students toward college or towards the CLAST between students who performed well and students who performed poorly on the computational skills of the CLAST.

H_{14}: There are no significant differences in perceived attitudes of parents between students who performed well and students who performed poorly on the computational skills of the CLAST.

Need for the Study

At the turn of the century, 8.5% of the youth population attended secondary schools of that day and 6.3% graduated from them (U.S. Department of Commerce, 1975).

The Committee of Ten established a common core of academic subjects for these schools which stressed mental discipline. The preparation for higher education and the preparation for work were essentially the same (Boyer, 1983).

During several swings of the academic pendulum, the curriculum as well as the population in the secondary schools expanded (Goodlad, 1984). Up to 75% of the young people of the 1970s graduated from high school (Boyer, 1983). School administrators of the 1970s attempted to provide a smorgasboard curriculum in order to meet vocational, social, and personal needs of students as well as their academic needs (Boyer, 1983). Emphasis was on equal rights and equal opportunity for all students (Goodlad, 1984).

While in the early 1900s higher education was considered by some to be an elitist institution (Cremin, 1961), it became nearly universal in the 1970s as community colleges placed it within commuting distance of most students (Gleazer, 1968). The open door philosophy allowed almost any student admission to college regardless of social class, sex, race, or lack of previous academic success (Moore, 1970; Roueche & Snow, 1977).

In the mid-1980s, the American public has decried the smorgasboard curriculum of the 1970s as lacking rigor, the "educational foundations of our society are presently being eroded by a rising tide of mediocrity," and "educational institutions seem to have lost sight of the basic purposes of schooling" (National Commission on Excellence in Education, 1983, p. 5). The current movement in the 1980s is toward increased emphasis on academics (National Commission on Excellence in Education, 1983).

In Florida, graduation requirements for two-year degrees were increased sharply by state mandate (Florida Administrative Code Rules 6A-10.30, 6A-10.31, 1982). In mathematics, for example, the requirements were increased from a single three-hour liberal arts course with little or no prerequisite in most community colleges to the state requirement of six hours at the level of college algebra or above (Florida Administrative Code Rule 6A-10.30, 1982). Also students are required to pass the state College-Level Academic Skills Test (CLAST) (Florida Administrative Code Rule 6A-10.31, 1982).

In 1982, the Florida Postsecondary Education Planning Commission recommended that all developmental and remedial programs in state community colleges and universities be eliminated by the year 1990 (The Master Plan, 1982). Although this restriction was later written out of the statutes (Florida Statutes, Section 240.117, 1984), this is an indication of the shifting political opinion concerning the role of developmental education and the open door community colleges. In 1984, the Florida Administrative Code established statewide placement standards. This rule also required that students not enroll for more than three semesters in each skill area to complete college preparatory (developmental) instruction (Florida Administrative Code Rule 6A-10.315, 1984).

It was assumed that meeting these increased academic requirements and regulations would require many changes in the curriculum and instruction, especially in the community colleges, which have traditionally been open door institutions (Thornton, 1966). A number of the students who enroll in these institutions may be classified as underprepared and in need of developmental or remedial work (Cross, 1971). Many "non-traditional" students, defined by Cross as adult learners who have had difficulty with academic work, and minority students will be greatly affected by these increased requirements and regulations.

It is for these underprepared students that a community college curriculum should be designed (Cross, 1976; Moore, 1970). Without a curriculum designed to assist these students to meet higher academic standards, equality of educational opportunity for all students will not be possible. Higher academic standards force institutions towards academic elitism, and underprepared, non-traditional students may become victims rather than benefactors of the new and "improved" standards (Moore, 1970). Adequate time, appropriate learning materials, and well-designed instruction are essential for such students (Bloom, 1971; Roueche & Snow, 1977).

Delimitations of the Study

This study was confined to students from one community college who completed the computations subtest of the CLAST from spring of 1985 through the summer of 1986. Students who scored at or below the minimum standard of the state board through July 31, 1989 (Florida Administrative Code Rule 6A-10.313, 1984), and an approximately equal number of the highest scoring students were interviewed, their records studied, and they were asked to complete instruments to determine personality type, cognitive style, and attitudes toward mathematics.

Limitations

The findings of this study may be generalized only to similar populations of community colleges with open door policies, similar curricula, and similar CLAST procedures. This study should not be generalized to non-similar populations within or outside of the state of Florida.

Population mobility was anticipated since many students graduated from the community college and transferred to universities for upper division work. This limited the accessibility of students to be interviewed.

Regarding high school background, there were considerable variations among the high schools, in breadth of curriculum content, nomenclature, and grading policies. Moreover, high school transcripts were not available in the records office for all students, since admission to the community college requires only proof of high school graduation or its equivalent.

The study may be subject to bias particularly in cases in which students (n = 20 of the 56) interviewed had been students in the mathematics classes of the interviewer. The possible use of an alternate interviewer was considered, since the interview format was standardized. However, familiarity and rapport with former students may have yielded additional insights and improved student cooperation. Moreover, the use of an alternate interviewer would have resulted in loss of control over the interview and would not necessarily have eliminated bias on the part of students. It was decided to conduct the interviews as originally planned.

Finally, correlations do not establish causation. No attempt was made to ascertain whether student differences effect CLAST performance. Rather the purpose in this study was to identify differences which may have impact on the curriculum.

Definitions

Affective characteristics include (a) cognitive style, (b) personality type, (c) attitude towards mathematics (mathematics anxiety), (d) attitude towards college, (e) attitude towards the CLAST and testing, and (f) recall of role models and experiences related to mathematics.

CLAST Review (IDS 1189) is a one-hour course offered by the college to review skills from each of the CLAST subtests.

College academic preparation refers to the following variables: (a) number of college credits earned, (b) community college grade point average, (c) number of college courses withdrawn or audited, (d) completion of IDS 1189 (CLAST Review) and (e) completion of the associate degree.

College mathematics preparation refers to the following variables: (a) number of mathematics courses completed at the level of intermediate algebra or above, (b) grade point average of all college mathematics courses, (c) number of mathematics courses withdrawn or audited, (d) enrollment in developmental mathematics courses, (e) enrollment in Finite Mathematics, (f) grade in Finite Mathematics, and (g) highest college mathematics course.

College preparatory courses (also known as developmental or remedial courses) are basic skills courses in reading, writing, mathematics, and study skills offered during 1985-86 in community colleges for non-college credit and designed to prepare students for academic work in college credit courses.

A cognitive style refers to the manner in which learners prefer to acquire and process information as assessed by the Style Delineator by Gregorc (1982).

Enrollment/employment status includes the variables: (a) number of credit hours taken during the semester in which the CLAST was taken, (b) number of hours employed per week during the semester in which the CLAST was taken, (c) previous work experience, and (d) current enrollment in higher education.

Essential skills are defined by the Florida Department of Education Task Force on Communications and Computations as "those tools of linguistic and mathematical literacy that students need to extract information, to exercise and develop the critical faculties of the mind, and to express thoughts clearly and coherently" (State Level Task Force, 1982, p. v).

Extreme group correlation refers to the correlation between variables in a population in which only extreme cases of the population are studied (Meyers, 1979).

Finite Mathematics (MGF 2202) is a course which includes logic, geometric measures, and probability and statistics.

A full range correlation is an estimate of the correlation that would have resulted for an entire population. This correlation is computed using the extreme group correlation and the standard deviations of the entire population and the combined extreme groups (Meyers, 1979).

Grade point average (GPA) on a four-point scale is the total quality points earned by a student at the community college divided by the total number of semester hours attempted for credit.

High risk factors are factors which are frequently characteristic of students likely to experience academic difficulty.

High school academic preparation refers to the following variables: (a) high school grade point average, (b) number of semesters of high school mathematics, (c) grade point average of high school mathematics courses, (d) highest high school mathematics course, and (e) type of high school curriculum.

High school curriculum refers to a high school course of study selected from the following: (a) college preparatory curriculum, (b) general curriculum, and (c) vocational curriculum.

High school mathematics semester credits are high school credits earned by students in the ninth grade or above at the rate of one credit per half year.

High school grade point average on a four-point scale is the total high school quality points earned by a student divided by the total number of credits attempted.

Intermediate Algebra (MAT 1033) is the first course in the algebra sequence for which college credit is awarded. For the 1986-87 year, this course was included in the state definition of courses at the level of college algebra or above.

Interdisciplinary studies are courses offered by community college instructors to teach students skills in more than one academic discipline. For example, CLAST Review (IDS 1109), is a one-credit hour course designed to review briefly the skills of all four CLAST areas as well as test-taking techniques.

Mathematics anxiety is a state of uneasiness or distress usually resulting from past or present experiences in mathematics, together with an apprehension of future experiences. In this study, levels of mathematics anxiety were as assessed by the Mathematics Anxiety Rating Scale (MARS) (Suinn, 1972).

Minimum standards for the College-Level Academic Skills Test are scale scores for each subtest which define minimum levels of attainment of communication and computation skills as set by the Florida State Board of Education. Set for three designated periods of time, the standards for each subtest increased progressively for each period: (a) August 1, 1984, through July 31, 1986; (b) August 1, 1986, through July 31, 1989, and (c) after August 1, 1989 (Florida Administrative Code Rule 6A-10.312, 1984).

Non-traditional students are college students of any age, race, or sex who for whatever reason might have problems with academic courses and who might benefit from developmental courses. Many nontraditional students are underprepared (Cross, 1976).

Personality type refers to the relative predominance in the personality of extraversion/introversion, sensation/intuition, thinking/feeling, and judging/perceiving as measured by the Myers-Briggs Type Indicator (Lawrence, 1982).

Placement test scores are scores from the American College Testing (ACT) Program or the Scholastic Aptitude Test (SAT).

Population mobility refers to the change of address of students in this study between the taking of the CLAST and the completion of the interview.

Socioeconomic status includes the following variables: (a) family income, (b) parents' occupations, and (c) parents' educational background.

Underprepared students are students of varying academic abilities but without skills necessary to perform successfully in college level academic courses.

Organization of Chapters

This study was organized as follows. In Chapter II, a review of related literature including a brief history of the College Level Academic Skills Test and a summary of research pertaining to CLAST are presented. Chapter III contains a description of the variables which were analyzed and research procedures. The findings of the study are reported in Chapter IV. A summary of the study with conclusions and recommendations for further study are provided in Chapter V.

CHAPTER II
REVIEW OF THE LITERATURE

Introduction

In this study, comparisons and contrasts were made between students who performed well and students who performed poorly on the computations portion of the College-Level Academic Skills Test (CLAST). The review of the literature begins with the historical background and development of the CLAST. This includes a summary of tests from other states that are related to the Florida CLAST. Following this is a review of research on the CLAST.

Information obtained was related to students' attitudes towards mathematics and testing and to students' personality types and cognitive styles. Therefore, a review of research on test anxiety and mathematics anxiety is included. Summaries of research on personality types and cognitive styles are included, together with descriptions of leading models and assessment instruments. Finally, since a major source of information for the study was the interview, this chapter concludes with principles and techniques of interviewing.

Historical Background of the CLAST

In the spring of 1979, the Florida Legislature passed House Bill 1689, a bill containing a variety of statutory changes concerning postsecondary education in Florida. The goals of this legislation were to insure that students entering their freshman year were correctly placed to acquire essential college-level communications and computations skills, and to insure that students entering their junior year had acquired those communications and computations skills deemed essential to success in the upper division (State Level Task Force, 1980).

The Articulation Coordinating Committee (1985) was charged with the responsibility of carrying out certain provisions of this bill. It was this committee that established the Essential Academic Skills Project, later known as the College-Level Academic Skills Project (CLASP) (State Level Task Force, 1980). According to a later report, the CLASP "was implemented to curb grade inflation and relaxation of graduation standards in postsecondary education in Florida" (Articulation Coordinating Committee, 1985, p. 1).

One of the responsibilities of this committee was to formulate a list of communication and computation skills. This was submitted to faculty of the community colleges and universities of Florida for review in February 1980. A revised list inviting faculty response was mailed in September 1980, and a final list of competencies was distributed in December 1983 representing a consensus of the best professional judgment of the State Level Task Force (1983). The latter was adopted by the State Board of Education as 6A-10.31 of the Florida Administrative Code.

Once the Florida Department of Education had determined that no test existed that measured all of the required skills, the Articulation Committee began test development. This test, known as the College-Level Academic Skills Test (CLAST), was designed to be an achievement test. It was intended to measure the level of achievement of the communications and computational skills required of all students by the completion of their sophomore year of college as set forth in Florida Administrative Code Rule 6A-10.31. The CLAST was not designed to be a predictor of subsequent performance of students in the upper division.

The first administration of the CLAST was in the fall of 1982. Beginning in August 1984, scores which satisfied the standards of Florida Administrative Code Rule 6A-10.312 were required for students to receive an Associate of Arts degree or to be admitted to upper division status in a state university in Florida. An additional statute required that all students who received state financial aid after August of 1985 participate in the CLAST. Thus an opportunity was provided for private colleges and universities to offer the CLAST at their initative to students not enrolled in public institutions (College-Level Academic Skills Project, 1984a).

Applying the 1984 standards as set forth in Florida Administrative Code Rule 6A-10.312 to CLAST results from previous years, the passing rate steadily improved: 72% in 1982-83, 87% in 1983-84, and 88% in 1984-85. Students of different racial groups varied in their ability to meet these standards. For the 1984-85 year, 94% of white students, 66% of black students, 82% of Hispanic students, 74% of Asian students, 84% of American Indian students, and 64% of students of other racial designation including foreign nationals passed each CLAST subtest. Applying the 1989 standards to the data of the 1984-85 year, 49% of white students, 15% of black students, 33% of Hispanic students, 36% of Asian students, 41% of American Indian students, and 21% of students of other racial designation passed all of the subtests (Articulation Coordinating Committee, 1985).

Recommendations based upon the 1984-85 data were (a) a common placement test designed to measure CLAST skills of entering freshmen; (b) studies to determine the impact of CLAST testing upon the enrollment and retention of minority students; (c) institutional effort to ensure that its students be prepared for the 1989 standards; and (d) communication with secondary schools as to the CLAST skills, placement test scores, and CLAST performance data of their particular students (Articulation Coordinating Committee, 1985).

According to Myron Blee (personal communication, March 25, 1986), manager of the CLAST office at the Florida

State Department of Education, Florida was the only state that had a statewide testing program designed to assess computational skills at the sophomore/junior level. However, several states were beginning to address the issues of quality education and its assessment. The state of Georgia has had the Rising Junior Level Test in effect for several years. There was no assessment of computations skills on the Georgia test, according to Blee, because of lack of agreement upon the mathematics requirements. In New Jersey, a test similar to the CLAST was used in placement as an admissions test for freshmen rather than as a sophomore exit test. The Florida Articulation Coordinating Committee was working with the Texas Legislature to initiate a testing program similar to the Florida CLAST (M. Blee, personal communication, March 25, 1986).

Research on the CLAST

Much of the research on the CLAST was conducted by the Office of Institutional Research, Miami-Dade Community College. Early reports from researchers in the Office of Institutional Research attempted to answer questions regarding the purpose, impact, and reliability of the CLAST.

Wright and Losak (1983) studied 455 students who entered Miami-Dade Community College in the fall of 1980, most of whom had earned a high school grade point average of 3.00. The success of these students in completing two full years of college-level coursework or achieving high grade point averages was compared to the students' performance on the Comparative Guidance and Placement Test. Wright and Losak concluded that subsequent academic success of high achieving students enrolling at Miami-Dade, for the most part, was unrelated to their performance on a standardized achievement test.

Losak and Morris (1983) attempted to demonstrate the impact of the CLAST with a model showing the flow of students by ethnic category through the Dade County Public Schools and Miami-Dade Community College. They concluded that considerable quality control of students was evident as a result of competition in the classroom. Furthermore, they concluded, artificial selection by means of standardized entrance and exit testing would serve to waste talent, with black non-Hispanic students projected to be the most severely impacted.

There have been attempts to establish the reliability of the CLAST. The CLAST Technical Reports 1982-83 (College Level Academic Skills Project, 1983) included the following Kuder-Richardson Formula 20 coefficients: (a) computations, .88 to .90; (b) reading, .85 to .87; and (c) writing, .69 to .72. The CLAST Technical Reports 1983-84 (College Level Academic Skills Project, 1984b) included the following Kuder-Richardson Formula 20 coefficients: (a) computations, .88 to .90; (b) reading, .85 to .87; and (c) writing, .69 to .72.

The State of Florida Department of Education (1984) in The Reliability of Classification Decisions on CLAST used two criterion-referenced methods. Using the Brennan and Kane (1977) Dependability index on the October 1983 data for over 14,000 students, the Department of Education obtained the following reliability coefficients: (a) computations, .96; (b) reading, .97; and (c) writing .92. In a second reliability study conducted by the Florida Department of Education, a sample of students (n=97) was paid to take an alternate version of the CLAST one week after the June 1983 administration. The proportions of consistent decisions (pass-pass or fail-fail) were summed for each subtest to form an Index of Agreement which was corrected for chance as follows: (a) computations, .96 (corrected to .69); (b) reading, .91 (corrected to .52), and (c) writing, .92 (corrected to .30).

Reicher (1984c) reported reliability coefficients for the October 1983 and the March 1984 administrations of the CLAST utilizing the KR-20 and KR-21 coefficients and the Dependability Index of Brennan and Kane (1977). Coefficients were computed for the total group, for each gender, and for the three major ethnic groups. As with the *CLAST Technical Report* of the College-Level Academic Skills Project (1984b), the computations subtest of the CLAST had the highest reliability coefficients and the writing subtest consistently had the lowest. Hispanic students and black non-Hispanic students usually had the lowest coefficients for the subgroups accompanied by a smaller range of reported scores for the group.

Several researchers have attempted to demonstrate the relationship between student coursework and student performance on CLAST. Belcher (1985b, 1985c) and Losak and Mannchen (1984) have shown that students who enter the community college with low placement test scores and students who enroll in developmental courses have lower passing rates on the CLAST in those areas.

Belcher, in three separate studies, analyzed the effects of specific mathematics courses at Miami-Dade Community College upon CLAST performance. In a study of 1581 students who completed the CLAST in June 1984, Belcher (1984a) compared students who had no grade in MGF 1113, a course similar to Finite Mathematics which was designed to help students prepare for the CLAST, to those who had successfully completed the course with a C or better. Students who successfully completed MGF 1113 were more likely to pass the CLAST than those who did not. Students who completed MGF 1113 were almost as likely to pass the CLAST as students enrolled in advanced mathematics courses.

Belcher (1985a) showed the relationship of grades in MGF 1113 and CLAST performance for students who attempted the CLAST in either the summer or fall of 1984. In this study, A students scored about 20 points higher than B students, while B students scored about 10 points higher than C students. In general, the more mathematics completed, the better the performance on the CLAST.

Belcher (1985b) further concluded that grades in MGF 1113 provided a better predictor of CLAST performance than any basic skills scores. While entering test scores were a better predictor of performance on the communications portion of the CLAST, the best prediction of the CLAST computations performance was the result of considering both the level of basic skills that the students brought with them to college and the curriculum they had experienced at the institution.

In a comparison of the top 50 CLAST scorers to the bottom 50 CLAST scorers at Miami-Dade Community College for the March 1983 administration of the CLAST, Losak, Morris, and Leone (1983) found that very few of the top 50 students earned Cs and Ds in CLAST-relevant courses. In contrast, they found that a large proportion of the bottom scorers earned Cs and Ds. Moreover, foreign students and students from the English-as-a-second-language program were prevalent in the bottom 50. Students of the lower group also tended to be older, to be enrolled at Miami-Dade Community College longer, and to have lower grade point averages than those in the higher group.

Belcher (1984b) contrasted a sample of students who failed two or more subtests of the CLAST with a sample who passed all four subtests of the June 1984 administration of the CLAST. The results were similar to those of the study by Losak et al. (1983), with the additional finding that higher students had five or fewer withdrawals, where those who failed two or more subtests accumulated as many as 22 withdrawals.

Mathematics and Test Anxiety

The negative effects of anxiety, especially test anxiety, upon academic performance were documented in the psychological literature (Aiken, 1976; Boodt, 1988; Cluts, 1984; Daniels & Hewitt, 1978; Deffenbacher & Deitz, 1978; Sachs, 1982; Sepie & Keeling, 1978). In response to this problem, several well-known instruments were developed to assess levels of anxiety. Those used to measure test anxiety and general anxiety included the Suinn Test Anxiety Behavior Scale (STABS) (Suinn, 1969), the Spielberger Test Anxiety Inventory (Spielberger, 1977), and several tests developed by I. G. and S. E. Sarason, such as the General Anxiety Scale (GAS) and the Test Anxiety Scale (TAS) (Sarason, 1957).

While excessive test anxiety is destructive, a reasonable amount may be beneficial, providing motivation to increase learning. Couch, Turner, and Garber (1979) developed the following profile of students with debilitative anxiety: (a) high pretest anxiety, (b) attention to past and future sections of the examination, (c) poor specific task attention, (d) fixated thinking about previous mistakes, (e) self-critical statements during the examination, (f) doubts of academic ability, (g) low academic self-perception, (h) lack of mental imagery during examination, and (i) poor academic performance attributed to test anxiety.

In contrast to this profile of students with debilitative anxiety, Couch et al. (1979) offer the following profile of students with facilitative anxiety: (a) low pretest anxiety, (b) attention to specific task at hand, (c) little thinking about previous mistakes, (d) little self-criticism during the examination, (e) little doubt of academic ability, (f) high academic self-perception, (g) high use of mental images during examination, and (h) poor academic performance attributed to unfair grading rather than test anxiety.

There is a positive relationship between test anxiety and several measures of self-esteem. Nunn (1976) showed that subjects exhibited a marked tendency to report decreased feelings of self-esteem, intellectual competence, and personal control as anxiety levels increased. Further implications point to the possibility of increasing positive perceptions of competence, self-esteem, and self-control as a means of correcting excessive levels of test anxiety.

Other researchers have addressed the question of the effect of sex and race upon test anxiety. Rodgers (1988) confirmed that female students and black students experienced higher levels of anxiety on the General Anxiety Scale. However, Daniels and Hewitt (1978) indicated the state of anxiety to be a highly consistent one with the results being the same for men and women. Daniels and

Hewitt did find a strong inverse relationship between anxiety and performance in a mathematics course.

In addition to general anxiety and test anxiety, students suffer from mathematics anxiety. Among the first instruments devised to measure mathematics anxiety were the Numerical Anxiety Scale by Dreger and Aiken (1957), the Mathematics Anxiety Rating Scale (MARS) (Richardson & Suinn, 1972), and the Mathematics Anxiety Scale by Fennema and Sherman (1976). Two additional forms of the Suinn test were a shortened form of the MARS (Plake & Parker, 1982) and the form MARS-A for adolescents (Suinn & Edwards, 1982).

While there is a relationship between mathematics and test anxiety, it has been shown that many students are affected by mathematics anxiety who are not necessarily highly anxious in other situations (Sepie & Keeling, 1978). Dew, Galassi, and Galassi (1983) investigated the relationship of mathematics anxiety to test anxiety in 769 college students. It was determined that although mathematics anxiety and test anxiety are related, they are not the same construct.

Rounds and Hendel (1988) examined the dimensionality of the Mathematics Anxiety Rating Scale (MARS) to identify and label factors as mathematics test anxiety and numerical anxiety. A significant result of this study was the fact that while 72% of the mathematics test anxiety scores indicated a fair amount of anxiety, only 6% of the numerical anxiety scores were that high. This finding is consistent with a study by Doyle (1978) in which he reported that the real problem for the mathematics anxious is not a numerical one, but rather it is the inability to apply symbolic procedures.

According to Morris (1981) mathematics anxiety is a learned response from a negative experience. Such experiences contribute in part to mathematics avoidance. Hilton (1980) described six features of a traditional mathematics curriculum that help establish mathematics avoidance: (a) rote calculations, (b) memory dependence, (c) unmotivated problems, (d) spurious applications, (e) authoritarianism, and (f) tests. According to Hilton, the prevalence of standardized tests, especially multiple choice tests with a premium on rote efficiency and memory, is one of the most harmful influences in education today. Such tests themselves generate anxiety and establish an undesirable association between education and anxiety.

Sachs (1982) investigated the relationship among students' incoming mathematics skills as measured by an achievement test, their mathematics anxiety at midterm, and their performance on the midterm in an introductory mathematics course. Significant correlations were reported for (a) higher entering skills and lower anxiety levels; (b) lower entering skills and higher anxiety levels; (c) entering skills and midterm scores; and (d) higher anxiety levels and lower midterm scores, regardless of the entering skills level.

Suinn and Edwards (1982), using the Mathematics Anxiety Rating Scale for Adolescents (MARS-A), showed an association of high anxiety students to low grade average in mathematics courses for two samples of students. Frary and Ling (1983) also found that students with higher levels of mathematics anxiety tended to receive lower course grades and lower grade-point averages.

In a study of 197 college students who were administered the Mathematics Anxiety Rating Scale (MARS), Alexander and Cobb (1984) reported that students who had taken Algebra II in high school experienced significantly less mathematics anxiety than those who had not taken Algebra II. Moreover, those with As and Bs in algebra or geometry experienced significantly less anxiety than did students with poorer grades. It was suggested that student performance in high school mathematics courses be monitored and early intervention provided.

These results of the study by Alexander and Cobb were consistent with those of prior studies by Betz (1977, 1978). Betz found that the strongest relationship between mathematics anxiety and any of the background variables was that found for the number of years of high school mathematics. Higher levels of anxiety were related to lower mathematics achievement test scores and to higher levels of test anxiety. Other studies with similar findings include those of Dreger and Aiken (1957) and Rounds and Hendel

(1980) who concluded that mathematics anxiety is prevalent among students who are poorly prepared in mathematics.

Researchers have attempted to determine the relationship of sex and mathematics anxiety with conflicting conclusions. Resnick, Viehe, and Segal (1982), in a study of 1,045 college freshmen, reported low levels of anxiety on the Mathematics Anxiety Rating Scale (MARS) and no large sex differences. Frary and Ling (1983) also reported no significant relationship between sex and mathematics anxiety. Roodt (1980) examined the relationship between anxiety towards mathematics and variables of sex, age, vocational preference, and ability (background) in mathematics. The only significant correlation found was that of ability in mathematics. Stroup and Jasnowki (1977), in a study of talented women having high mathematics scores and at least three years of high school mathematics, reached a similar conclusion. These talented women were not generally avoiding mathematics because they were anxious. These researchers confirmed the conclusion reached by Aiken (1975) that there is a disparity between female and male enrollment in mathematics courses, but that this phenomenon is best explained by other more established constructs than by mathematics anxiety.

Sander and Betz (1981), Betz (1977, 1978), and Blayer, Pederson, and Elmore (1981), however, reported sex differences for mathematics anxiety. In a study of college students, Betz found that mathematics anxiety occurs frequently, and it is more likely to occur among women, especially those with inadequate high school backgrounds. According to Bander and Betz, females reported higher levels of mathematics anxiety, test anxiety, and two measures of trait anxiety, with the greatest difference between males and females being in mathematics anxiety. Blnyer et al. (1981) suggested that females have higher levels of mathematics anxiety, that females do not perceive mathematics as useful for their career goals, and that females indicate a stronger desire to avoid mathematics when possible. Sherman (1983) compared the attitudes of 63 girls who took two or more years of high school mathematics. It was determined that the anxiety level decreased as females continued in mathematics and their attitudes toward mathematics became more positive.

Mathematics anxiety apparently is a serious problem for many black students. McClellan (1984) listed seven causes for such anxiety as (a) low expectations and callous reactions of teachers to student questions, (b) overemphasis on fundamental and computational procedures rather than on creative problem solving, (c) parental expressions of their mathematics difficulties, (d) inadequate knowledge of black achievement in science and engineering, (e) the belief that special talents are needed, (f) the belief that mathematical ability is inherited rather than developed, (g) and the failure to be properly trained in the early grades.

Several researchers have attempted to relate mathematics anxiety to self-concept and personality factors. Wilhelm and Brooks (1980) established a positive relationship between parents' anxiety, self-concept, enjoyment of and perceived value of mathematics with these attitudes of their adolescent children.

Futuro and Lang (1982) determined that teaching strategies designed to help students in a community college to build positive and realistic self-concepts would have significant effects upon attitudes, anxiety, and achievement in a survey of mathematics course. Students in the experimental group performed better, developed more favorable attitudes, and had less anxiety than those of the control group.

Frary and Ling (1983), in a study of 491 college students, compared student attitudes toward mathematics to other personality characteristics. A notable absence of relationship between mathematics anxiety and personality variables was revealed. Approaching mathematics anxiety from the standpoint of conventional personality theory may not be worthwhile. Rather there appears to be hope that mathematics anxiety is a relatively superficial condition and that it may be responsive to simple desensitization.

Clute (1984) compared mathematics anxiety to instructional method and achievement in a survey course in college mathematics. In this study, students with high levels of anxiety had significantly lower achievement.

Students with high anxiety benefited more from the expository approach, while the low anxiety students benefited more from a questioning or discovery approach. Hodges (1983) suggested investigation of learning styles as a remedy for mathematics anxiety.

Many interventions and remedies have been proposed. Hendel and Davis (1978) suggested that maximum effectiveness in reducing mathematics anxiety was achieved when the participants enrolled in a mathematics course and also attended a multifaceted counseling support group. They indicated that there had been a significant impact in terms of decreasing math anxiety and increasing the mathematics-related skills of those who had participated in all components of the program. One caution which emerged was the need for those who enroll to be aware of the time commitment for homework that is necessary, since many of the subjects fell behind in their work and eventually dropped the course. Also, there is a need for the students to be committed to dealing with their mathematics anxiety (Hendel, 1977; Hendel & Davis, 1978; Mathison, 1979).

Faculty selection is one of the critical factors in the success of a mathematics program, its ability to retain students, and the students' ability to master course content. Aiken (1976) found the instructor to have significantly more influence than the curriculum in the development of attitudes towards mathematics. Hendel (1977), in his evaluation of the Mathematics Anxiety Program at the University of Minnesota, found that almost all positive comments to which students attributed their success focused on the instructor: the instructor's approachability, willingness to help students individually, and ability to present material clearly.

Kitchens (1989) suggested that future studies should focus on stress reduction by developing strong mutual concern among class members, by incorporating school work into the students' meaning system, and by developing methods for more efficient learning.

Personality Type and Cognitive Style

It is clear that instruction cannot be improved by finding the "one best method" or the methods that are best for all people (Cross, 1976). Individuals have different personality types and characteristic "styles" for collecting and organizing information into useful knowledge. Sizer's (1984) first imperative for better schools was to give teachers and students room to work and learn in their own appropriate ways.

Work in the area of psychological types was pioneered by Swiss physician-psychologist, C. G. Jung (1959). According to Jung, many individual differences may be explained by tendencies toward introversion or extraversion. This does not mean that an individual is completely one type or the other, but rather that there is a natural preference for one type over the other.

In addition to introversion (I) and extraversion (E), other basic psychological functions include tendencies or preferences toward sensation (S) or intuition (N), thinking (T) or feeling (F), and judging (J) or perceiving (P). The sensing (S) person prefers to focus on the solid facts of experience as received through the five senses, whereas the intuitive (N) person likes to use the imagination and intuition in problem solving. The thinking (T) type likes to make decisions logically and often pays more attention to ideas and principles than to human relationships, while the feeling (F) type tends to be more aware of human values and personal feelings even though they are not logical. Those who may be described as judging (J) types prefer a more structured lifestyle, with plans and decisions made in advance. They tend to live by standards and beliefs not easily changed. By contrast, the perceiving (P) types prefer flexibility, and they tend to avoid fixed plans (Lawrence, 1982).

Several instruments are available to measure personality type, including the Myers-Briggs Type Indicator (Briggs & Meyers, 1985) and the Keirsey Temperament Sorter (Keirsey & Bates, 1984). Insights into strengths and weaknesses of students may be observed by analysis of personality types, and strategies may be planned to assist students as they develop and learn. Teachers can help students learn their own natural tendencies for thinking, feeling, sensing, and intuition and improve areas of weakness (Lawrence, 1982).

> Extraverted children can be helped to extravert effectively, but also to enjoy their own company and thoughts. Introverted children can be given more time to work alone and to go into depth in studies, but can also be encouraged to learn the skills of extraverting--in the interest of having more experiences to think about. (Lawrence, 1982, p. 53)

As students differ in personality type, they also may differ in cognitive style. At least a dozen separate cognitive dimensions have been the subject of systematic research study, and many models have been devised in an attempt to measure and evaluate these dimensions of learning style (Cross, 1976).

The field-dependence/independence dimension of cognitive style was advanced by Witkin and Moore (1975). This refers to the global (dependent) or broad way of viewing problems and situations as contrasted to the analytical (independent) or narrow view of situations. The field-dependent person sees the whole instead of the parts and is able to view the problem in a broad sense. The field-independent person is able to focus on the parts, separating the elements and viewing them independent of the background (Cross, 1976; Witkin & Moore, 1975).

An instrument by Gregorc and Ward (1977), known as the Transaction Ability Inventory or Style Delineator, is designed to assess two dualities that influence teaching and learning: abstract/concrete and sequential/random. The abstract/concrete duality refers to the tendency to perceive in a mental, symbolic, intuitive, or emotional way, as opposed a realistic or a physical way. The sequential/random continuum refers to the ability of the mind to order information, knowledge, and ideas sometimes in a step-by-step, methodical way, and sometimes in a nonlinear or leaping way. Those interviewed by Gregorc revealed use of all four modes. However, most expressed a distinct preference for one or two means of acquiring information (Gregorc & Ward, 1977).

The Interview

One of the leading authorities on the interview and interview techniques is Spradley (1979). According to Spradley, the interview makes possible a greater depth of information than other instruments. Information is obtained from persons whom he calls informants. These informants, not to be confused with subjects, friends, respondents, or actors, may be described as native speakers, sources of information, or teachers for the interviewer. According to Spradley, the interviewer attempts to understand the world from the informant's point of view.

Using an interview, certain ethical principles must be observed. The paramount responsibility is to protect the physical, social, and psychological welfare of those who are to be studied and to honor their privacy and dignity. An interviewer always pries into the lives of informants, revealing information that can be used to affirm their rights and sensitivities or to violate them. The informants have a right to know the aims of the investigator, and they have the right to remain anonymous. It is the responsibility of the interviewer to protect the anonymity of those who are interviewed. Permission to take notes or to tape record the interview should be obtained from the informant before the interview. What is written should be made available to the informant (Spradley, 1979).

The interview is different from a friendly conversation in that the questions (interviewer) and answers (informant) are not balanced. Also, a repetition or restating of questions frequently occurs. Expressions of interest and ignorance on the part of the interviewer are important in order to reassure the informant that the information is not boring or a repetition of something already known to the interviewer. Although a certain apprehension and uncertainty are normal in the beginning of the interview, it is very important to develop rapport. The interview should be a harmonious relationship between the interviewer and the informant in which both should feel comfortable and which both should enjoy (Spradley, 1979).

Summary of Literature Reviewed

The College-Level Academic Skills Test was initiated by the Florida Legislature in 1979 to ensure the quality of computations and communications skills of students receiving the Associate of Arts degree and/or entering the upper divisions of Florida universities. The CLAST was first administered in the fall of 1982, with passing standards established for the first time in August of 1984. Higher standards became effective in July of 1986, with still higher standards effective in 1989.

While most students passed by the 1984 standards, and little change was forecast for the 1986 standards, only 44% of these students would have passed by the 1989 standards. Minorities, especially black students, had lower passing rates by the 1984 standards and only 15% would have passed by the 1989 standards.

The CLAST has been the subject of many studies, most of which were performed by the Office of Institutional Research, Miami-Dade Community College. It was determined that entering skills and the curriculum experienced together are the best predictors of performance on the CLAST. Students who scored lower on the CLAST tended to have lower grade point averages and many more withdrawals from courses than those who scored higher.

For many students who take the CLAST, test anxiety and mathematics anxiety are likely to have a significant effect. Researchers have shown relationships between self-esteem and both test anxiety and mathematics anxiety. The correlations of sex and race with test anxiety and mathematics anxiety have varied. In some studies no significant differences were observed, while in other studies higher levels of anxiety were observed for females and black students.

While mathematics anxiety and test anxiety are themselves related, they are not the same since many students are affected by mathematics anxiety who are not necessarily anxious in other situations. It appears that only a small part of mathematics anxiety is numerical anxiety. Rather, much of mathematics anxiety is related to the abstract nature of mathematics and to a lack of experience in abstract thinking.

The strongest variable affecting mathematics anxiety appears to be the mathematics background, in particular, performance in high school Algebra II (Alexander & Cobb, 1984). Many interventions to assist students with mathematics anxiety have been proposed. The most significant variables pertain to faculty, including instructor attitudes, willingness to help students, and ability to present material clearly. Mutual support of class members, peer tutoring, and commitment to homework are also important in overcoming mathematics anxiety.

CHAPTER III
METHODOLOGY

General Research Design

This researcher surveyed community college students by written instruments and by personal interviews. The purpose was to compare and contrast students who scored poorly on the computations subtest of the College-Level Academic Skills Test with those who performed well on this test. In an attempt to discover those factors which were common or not common to both groups, data delineated in the data outline of Appendix A were obtained from student transcripts, attitude questionnaires, and telephone interviews.

Sample

The population in this study consisted of 56 students from one community college out of 724 students who attempted the computations subtest of the CLAST for the first time from the spring of 1985 through the summer of 1986. Students (n=28) who scored below 275, the minimum score required by the State Board through July 31, 1989 (Florida Administrative Code Rule 6A-10.312, 1984), and an equal number of the highest scoring students (above 359) were selected for study.

Analysis of the Data

Two single-blind groups were studied in order to answer the four research questions comparing the students who performed well and those who performed poorly on the computations subtest of the CLAST. The groups were defined (a) HS--high scoring students, or students who scored 360 or higher on the computations subtest of the CLAST, and (b) LS--low scoring students, or students who scored 275 or lower on the computations subtest of the CLAST.

A frequency table was constructed, and the descriptive statistics of mean, median, mode, range, kurtosis, and skewness were computed for the CLAST computations scores for the combined groups. Descriptive statistics of sex, race, age, and citizenship were noted for the two groups.

The independent variable in this study was the CLAST computations group. Statistical procedures for analyzing the dependent variables by groups were mandated by the ordered or discrete nature of the variables and by the availability of complete data sets. For ordered variables, such as age, various test scores, and grade point averages, the groups were compared by either multiple analysis of variance (MANOVA) or a one-way analysis of variance (ANOVA). Multiple analysis of variance followed by multivariate F tests was used to determine if statistically significant differences at the .05 level existed among several variables evaluated. When the multivariate F value of MANOVA was significant, it was followed by univariate F tests to determine which of the variables were significant.

Since MANOVA automatically deletes all cases with incomplete data, it was necessary to perform MANOVA in four separate applications. The first category included ordered variables with all data cases (n=56) complete: (a) age, (b) number of years between high school and CLAST, and (c) other CLAST scores.

The second category included ordered variables for students (n=55) with coursework in the community college: (a) number of college credits earned, (b) community college grade point average, (c) number of mathematics courses at the level of intermediate algebra or above, (d) grade point average of all college mathematics courses, (e) number of college courses withdrawn or audited, and (f) number of mathematics courses withdrawn or audited.

The third category included ordered variables for students (n=43) whose high school transcripts were available: (a) high school grade point average, (b) number of high school mathematics semesters, and (c) grade point average of high school mathematics courses.

The fourth category included ordered variables for students (n=46) who completed the written instruments. (a) scores from Mathematics Anxiety Rating Scale, (b) scores on Myers-Briggs Type Indicator, and (c) scores on Gregorc Style Indicator.

One-way analysis of variance was performed to establish whether any statistically significant differences existed at the .05 level for the remaining ordered variables:
(a) placement test scores, (b) Finite Mathematics grade,
(c) credit hours taken during semester of the CLAST, and
(d) hours employed per week during semester of the CLAST.

Since the MANOVA and one-way test are appropriate only for ordered variables, chi-square analysis followed by the Yates Correction was applied to the following discrete variables: (a) sex, (b) race, (c) citizenship, (d) family income, (e) parent education, (f) parent occupation,
(g) work experience, (h) enrollment in university,
(i) major, (j) career plans, (k) high school curriculum,
(l) highest high school mathematics course completed,
(m) completion of IDS 1189, (n) completion of associate degree, (o) enrollment in developmental mathematics,
(p) completion of Finite Mathematics, (q) highest college mathematics course completed, (r) difficulty with CLAST,
(s) preparation for CLAST, (t) cognitive style as measured by the Gregorc Style Delineator, (u) field-dependence or independence, (v) childhood experiences and role models,
(w) personality type as measured by the Myers-Briggs Type Indicator, (x) general attitude toward CLAST, (y) general attitude toward college, (z) motivation for attending college, and (aa) perceived attitude and general support of parents. For statistical analysis, the attitude variables

determined from the interviews were organized into positive, negative, and neutral categories.

Correlations were computed for all ordered variables, using the Pearson r for variables compared by multiple analysis of variance or one-way analysis of variance. For discrete variables for which ordering is meaningful, including dichotomous variables, Kendall's Tau B correlations were computed.

These correlations compared a number of variables by CLAST computation group, but the comparisons included only extreme cases, the upper 4% of students who took the CLAST and the lower 4% of these students. Extreme group correlations were used to estimate correlations for the entire population, even though data for the entire population were not available. These estimated correlations, known as full range correlations, correct for spurious data when comparing only the extreme cases of a population (Meyers, 1979).

Instrumentation

Data from student transcripts (Appendix B) were collected from the office of student records prior to the interviews. These records consisted of demographic data on age, sex, and race; high school mathematics courses and high school grade point average if available; placement test scores of the American College Testing Program or the Scholastic Aptitude Test if available; college grade point average, college mathematics courses taken, number of courses withdrawn or audited, and total credits earned; and CLAST reading, writing, and essay scores.

Written instruments were used to ascertain student personality type, cognitive style, and attitudes (Appendix D). Personality type was determined by the general form (126 items) of the Myers-Briggs Type Indicator (MBTI) (1977). Test-retest reliability coefficients ranged from .48 to .87. Validity data were presented to show a relationship to personality measures, SAT performance, and various interest scales (Mitchell, 1985).

Students were instructed to answer only the first 95 items, because the additional items are experimental. Responses were hand-scored with scoring masks for each of the following dimensions: (I) introversion, (E) extraversion, (S) sensation, (N) intuition, (T) thinking, (F) feeling, (J) judging, and (P) perceiving.

Cognitive style was assessed by use of the Style Delineator by Anthony Gregorc (1982). Test-retest reliability coefficients, retest within eight weeks of first test, ranged from .85 to .88, while predictive validity correlations ranged from .55 to .76 (Gregorc, 1984). For each of 10 sets of 4 words, the respondent was asked to rank the words in each set in order of personal preference, with 4 the "most descriptive of you" and 1 the "least descriptive of you." The scores indicated tendencies toward a learning style that is (CS) concrete and sequential, (AS) abstract and sequential, (AR) abstract and random, or (CR) concrete and random. This instrument was supplemented by seven questions (Appendix E) to determine field-independence versus field-dependence (Witkin & Dyk, 1962).

Attitudes toward mathematics were measured by the Mathematics Anxiety Rating Scale (MARS) by Suinn (1972). While test-retest reliability data ranged from .78 to .85 with internal consistency reportedly .97, these data were reported without item development procedures. These could be misleading, since the inclusion of non-discriminating items can artificially inflate reliability coefficients. Evidence of validity as reported in the form of moderate negative correlations with mathematics aptitude could be suspect. While the MARS was in need of additional documentation to justify claims for it, no better instruments were available (Mitchell, 1985).

The MARS is a 98-item scale designed to assess the level of anxiety experienced in a variety of mathematics-related situations. Responses were given on a scale of 1 (low anxiety) to 5 (high anxiety), where the total score was computed by summing the numerical ratings of all the items. Ten of the items from this instrument related to test anxiety. These 10 items and an additional 10 items deemed most relevant to community college mathematics were selected for individual item analysis and also considered as subtest scores of the Mathematics Anxiety Rating Scale.

The written instruments were mailed to participating students and returned by mail upon completion. The data were organized for study into categories of high scoring and low scoring students as determined by student scores on the computations subtest of the CLAST.

Interview data were collected following a standard format (Appendix C). All data were coded for analysis using the Statistical Package for Social Sciences (SPSSx) on the IBM 4381 computer.

Collection of Data

Students selected for the interview were first informed by letter (Appendix F) of their selection to the study. A week later, attempts were made to reach the students by telephone to confirm their participation. Of the 56 students, 22 telephone numbers were not in service. For these students, an address correction was requested through the postal service. A second letter (Appendix G) with return postcard was sent to the 15 students whose numbers could not be obtained from directory assistance. Of these students, 7 responded.

Of the 46 students who were located by telephone, 45 agreed to participate. For these students, a date and time for a telephone interview within 30 days was arranged. The written instruments were mailed with instructions that the students complete and return them as soon as possible, preferably before the interview. Two students, not accessible by telephone, completed the interview by mail. Of the 47 students who agreed to participate in the study, 1 failed to complete the interview, and 1 failed to complete the instruments.

Data from the office of student records (Appendix B) were compiled before the interview. These data consisted of age, sex, race, citizenship, years between high school and college, placement test scores, college mathematics courses and grades, number of college credits earned, number of withdrawals, and grade point averages. There were 13 students in the study whose high school transcripts were not available in the office of student records. Request for transcripts was made for those students from U.S. high schools. Of 56 students in the study, 43 high school transcripts were obtained. For these students high school grade point averages, mathematics courses, and grades earned were studied.

Data from the interview itself were collected on the interview data sheet (Appendix C). These data consisted of additional demographic data, socioeconomic status and parent educational background, current employment and/or transfer status, present course of study, and preparation for the CLAST. Other questions in the interview solicited positive, negative, and/or neutral responses to role models and influences from childhood, adolescence, high school, and college; students' attitudes toward education, mathematics, and testing; and parents' perceived attitudes toward education, mathematics, and testing. Notes on these responses were made by the interviewer for descriptive analysis. For each such question, the interviewee was then asked to summarize the response in a quantifiable answer: positive, neutral, or negative.

CHAPTER IV
FINDINGS

This study was designed to compare students from a particular community college who performed well on the CLAST computational skills with those students who performed poorly on these skills. Factors which correlated with successful completion of the computations subtest of the CLAST were identified. Similarly, characteristics of students who scored below the 1986 cut-off scores were contrasted with the characteristics of the highest scoring students from the same community college.

Four research questions concerning differences between high scoring and low scoring students of the computations subtest of the CLAST were addressed in this study. Fourteen null hypotheses concerning demographic data, performance on other standardized tests, academic background, and affective characteristics were tested.

In this chapter the researcher reports the findings of this study in five sections. The first describes the total population of students from the community college who attempted the CLAST from the summer of 1985 through the summer of 1986. The remaining sections address each of the four research questions.

Analysis of Total Population and Combined Samples

The students in this study were selected from a total population of 724 students, whose frequency distribution by sex and race is shown in Table 1. By sex, female students comprised 57.0% and male students 43.0% of the population. By race, white students composed 89.0%, black students 3.3%, Hispanic students 2.2%, Asian students 0.8%, and students of other racial designation 4.7%.

The mean CLAST computations score for all 724 students was 312.3 with standard deviation 24.7. This compares with the mean 320.3 and standard deviation 60.9 for the 56 extreme students in this study. Data for these extreme students, the subjects of this study, on the CLAST computations subtest are presented in Table 2.

Table 1

Frequencies for Total Population

Female Population		Male Population		Total Population	
White Female	366	White Male	278	Total White	644
Black Female	21	Black Male	3	Total Black	24
Hispanic Female	5	Hispanic Male	11	Total Hispanic	16
Asian Female	4	Asian Male	2	Total Asian	6
Other Female	17	Other Male	17	Total Other	34
Total Female	413	Total Male	311	Grand Total	724

Table 2

A Descriptive Analysis of CLAST Computations Scores for Combined Samples

Mean	320.30	Median	317.00
Standard Deviation	60.94	Mode	375.00
Standard Error	8.14		
Range	193.00	Skewness	.09
Minimum	232.00	Kurtosis	-1.77
Maximum	425.00		

Table 3

A Comparison of Age, Years Between High School and CLAST, CLAST Reading, CLAST Writing, and CLAST Essay Scores of Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Variable	Group	Mean	Standard Deviation	Univariate F Value	p
Age	LS	24.86	8.15		
	HS	24.21	5.29	.12	.720
Years Between High School and CLAST	LS	6.10	6.97		
	HS	5.14	4.62	.43	.515
CLAST Reading	LS	283.29	22.69		
	HS	335.32	34.33	44.77	.000*
CLAST Writing	LS	283.93	22.06		
	HS	343.54	37.90	51.50	.000*
CLAST Essay	LS	4.29	1.63		
	HS	6.00	1.12	21.02	.000*

Multivariate F = 13.95; df = 1, 54; p = .000*
HS (n=28); LS (n=28)
* p < .05

Research Question #1:
Descriptive Analysis of High Group Versus Low Group

The first research question was concerned with the demographic characteristics of students who performed very well on the computations subtest of the CLAST compared with those students who performed poorly. Two null hypotheses relate to this question. The first null hypothesis stated that there are no significant differences in age, sex, race, citizenship, or socioeconomic status between the two groups.

In the first MANOVA age and the number of years between high school and the CLAST were compared for the two groups. The results are presented in Table 3. Other CLAST scores were included in this MANOVA since the data for these variables were available for all students in the study. The mean age for each of the groups was between 24 and 25 years differing by less than a year. The number of years between high school and CLAST for the groups differed by a year with means of 6.18 and 5.14 years respectively. The low scoring students were slightly older, but the difference was not significant for $p < .05$.

The variables sex, race, citizenship, and family income, found in Tables 4 through 7 respectively, were analyzed using the chi-square procedure followed by the Yates Correction as necessary. For these chi-square tests, the only variable which resulted in a significant difference ($p < .05$) between high scoring and low scoring groups was race, with a chi-square value of 16.53. While no students

Table 4

A Comparison Between Male and Female Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	Male	Female	Row Total
LS	7	21	28
HS	14	14	28
Column Total	21	35	56

Chi-square after Yates Correction = 2.74, df = 1; p=.0977
Kendall's Tau B = -.2582, p=.0278*
Full range correlation = -.0794
* p < .05

Table 5

A Comparison of Race Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	White	Black	Asian	Hisp	Other	Row Total
LS	13	18	3	1	1	28
HS	26	0	2	0	0	28
Column Total	39	18	5	1	1	56

Chi-square = 16.53; df = 4; p = .0024*
* p < .05

Table 6

A Comparison of Citizenship Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	USA	Other	Row Total
LS	22	6	28
HS	27	1	28
Column Total	49	7	56

Chi-square after Yates Correction = 2.61; df = 1; p = .1060
Kendall's Tau B = -.2700; p = .0226*
Full range correlation = -.0832
* p < .05

Table 7

A Comparison of Family Income Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	Low	Medium	High	Row Total
LS	9	7	6	22
HS	3	10	11	24
Column Total	12	17	17	46

Chi-square = 4.92, df = 2; p - .0853
Kendall's Tau B = .2753; p = .0253*
Full range correlation = .0645
* p < .05

of black, Hispanic, or other racial designation were included in the high scoring group, there were a total of 12 such students in the low scoring group. Kendall correlations for sex, citizenship, and family income, .26, .27, and .28 respectively, were significant at the .05 level, but full range correlations for these variables were not significant.

Other variables that related to socioeconomic status were parent occupations and educational levels of parents. These variables were analyzed using the chi-square test and the findings are presented in Tables 8 through 11. Educational levels of the father and mother, with chi-square values of 16.22 and 12.19, were significant for $p < .05$. While correlations also were significant, .26 and .24 respectively, the full range correlations of .08 and .07 were not significant. Differences in parent occupations between the groups were not significant.

Therefore, the first null hypothesis--that there are no significant differences in age, sex, citizenship, or socioeconomic status--was partially rejected because of the analyses related to race and educational level of mother and father. Significantly fewer non-white students were in the higher group. Also, parents of students in the higher scoring group were more likely to have attended college and earned higher degrees than parents of students in the lower scoring group.

Table 8

A Comparison of Father's Education Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	Ph.D.	M.A.	B.A.	A.A.	H.S.	Less	Un-known	Row Total
LS	0	0	2	8	5	5	2	22
HS	1	6	6	3	7	1	0	24
Column Total	1	6	8	11	12	6	2	46

Chi-square = 16.22; df = 6; p = .0126*
Kendall's Tau B = -.2598; p = .0254*
Full range correlation = -.0797
* $p < .05$

Table 9

A Comparison of Mother's Education Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	M.A.	B.A.	A.A.	H.S.	Less	Row Total
LS	0	1	7	9	5	22
HS	1	6	3	14	0	24
Column Total	1	7	10	23	5	46

Chi-square = 12.19; df = 4; p = .0160*
Kendall's Tau B = -.2375; p = .0420*
Full range correlation = -.0728
* $p < .05$

Table 10

A Comparison of Father's Occupation Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	Self	Sales	Prof/ Manag	Military	Trades	Decease	Row Total
LS	3	2	4	2	7	3	21
HS	4	4	7	2	5	2	24
Column Total	7	6	11	4	12	5	45

Chi-square = 1.97; df = 5 ; p = .8533

Table 11

A Comparison of Mother's Occupation Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	Self	Sales	Prof/ Manag	Homemaker	Human Serv	Secre	Trade	Decease	Row Total
LS	2	2	2	10	2	4	0	0	22
HS	1	2	4	7	3	3	3	1	24
Column Total	3	4	6	17	5	7	3	1	46

Chi-square = 5.80; df = 7; p = .5637

The second null hypothesis stated that there are no significant differences in enrollment/employment status, majors, or career plans between students who performed well and those who performed poorly on the computational skills of the CLAST. Data relevant to this hypothesis are presented in Tables 12 through 18. The variables number of credit hours taken during the semester of the CLAST and the number of hours employed per week during the semester of the CLAST were analyzed by separate one-way analysis of variance tests. Results of these tests are related in Tables 12 and 13. For both variables, the average class load and work load for the lower scoring group were slightly more than the average for the higher group, but the differences were not significant for $p < .05$.

Table 12

A Comparison of the Number of Credit Hours Taken in Semester of CLAST Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	Mean	Standard Deviation	N
LS	10.43	11.19	28
HS	8.68	4.75	28

Source	df	SS	MS	F
Between Groups	1	42.88	42.88	.58
Within Groups	54	3990.96	73.91	

Table 13

A Comparison of the Number of Hours Worked During the Semester of CLAST Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	Mean	Standard Deviation	N
LS	24.00	17.61	22
HS	19.54	14.50	24

Source	df	SS	MS	F
Between Groups	1	228.15	228.15	.88
Within Groups	44	11403.96	259.10	

Table 14

A Comparison of Work Experience Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	No	Yes	Row Total
LS	6	15	21
HS	4	20	24
Column Total	10	35	45

Chi-square after Yates Correction = .36; df = 1; p = .5492
Kendall's Tau B = .1429; p = .1717
Full range correlation = .0522

Table 15

A Comparison of Current Enrollment in Higher Education Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	No	Next Term	Yes	Row Total
LS	4	3	15	22
HS	0	2	22	24
Column Total	4	5	37	46

Chi-square = 5.45; df = 2; p = .0656
Kendall's Tau B = .3050; p = .0179*
Full range correlation = .0940
* p < .05

Table 16

A Comparison of Enrollment in Universities Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

	CC	UCF	UF	FSU	Other Fla	Non-Fla	Pri-vate	Row Total
LS	3	7	1	3	1	1	2	18
HS	0	16	3	0	1	3	1	24
Column Total	3	24	4	3	2	4	3	42

Chi-square = 10.56; df = 6; p = .1029

Table 17

A Comparison of Majors Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	Business	Computer	Educ	Engin	Human Arts	Math Sci	Medicine	Soc Sci	Row Total
LS	8	0	1	0	5	0	1	6	21
HS	4	2	2	7	4	1	2	2	24
Column Total	12	2	3	7	9	1	3	8	45

Chi-square = 13.97; df = 7; p = .0517

Table 18

A Comparison of Career Plans Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	Undec	Bus	Computer	Educ	Engn	Arts	Med	Soc Sci	Grad Sch	Row Total
LS	2	9	0	0	0	3	1	3	4	22
HS	3	4	2	4	7	1	0	0	3	24
Column Total	5	13	2	4	7	4	1	3	7	46

Chi-square = 20.22; df = 8; p = .0095*
* $p < .05$

The chi-square comparison of the variables work experience at the time of the CLAST, current enrollment in higher education, university of current enrollment, and major all resulted in non-significant differences (Tables 14 through 17 respectively). The Kendall correlation computed for work experience was .14 and was not significant for $p < .05$. The Kendall correlation for current enrollment in higher education, .31, was significant for $p < .05$, but the full scale correlation, .09, was not significant. The comparison of career plans (Table 18) resulted in the only significant difference between the groups for this hypothesis.

The second null hypothesis--that there are no significant differences in enrollment/employment status, majors, or career plans--was rejected only in terms of career plans. While more of the lower group anticipated careers in business, arts, and social science fields, more of the higher group planned careers in computers, education, and engineering.

Research Question #2: Comparison of Groups by Performance on Other Standardized Tests

The second research question concerned whether or not there were significant differences between high scoring and low scoring groups in performance on the other subtests of the CLAST and on ACT or SAT placement tests. The third null hypothesis stated that there are no significant differences in placement test scores between students who performed well and students who performed poorly on the computational skills of the CLAST.

The results of the one-way analysis of variance tests for ACT scores and SAT scores are provided in Table 19 and Table 20 respectively. For each of the eight placement tests studied, the high scoring group averaged significantly higher than the low scoring group. Summaries of the mean scores for each group and the corresponding F values are provided in Table 21. The highest F value was obtained for ACT Composition (143.19), with SAT Mathematics second (106.74), and ACT Mathematics third (99.12).

Table 19

A comparison of American College Testing Program Scores Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Test	Group	Mean	Standard Deviation	N
ACT English	LS	11.75	3.64	16
	HS	23.22	2.99	9

Source	df	SS	MS	F
Between Groups	1	748.08	758.08	64.44*
Within Groups	23	270.56	11.76	

Pearson r = .86*; Full range correlation = .34*
* p < .05

Test	Group	Mean	Standard Deviation	N
ACT Mathematics	LS	6.50	4.47	16
	HS	26.78	5.59	9

Source	df	SS	MS	F
Between Groups	1	2368.44	2368.44	99.12*
Within Groups	23	549.56	23.89	

Pearson r = .90*; Full range correlation = .37*
* p < .05

Table 19--Continued

Test	Group	Mean	Standard Deviation	N
ACT Sociology	LS	9.37	4.84	16
	HS	24.00	3.08	9

Source	df	SS	MS	F
Between Groups	1	1232.01	1232.01	66.24*
Within Groups	23	427.75	18.60	

Pearson r = .86*; Full range correlation = .34*
* p < .05

Test	Group	Mean	Standard Deviation	N
ACT Natural Science	LS	12.31	4.19	16
	HS	28.56	3.69	9

Source	df	SS	MS	F
Between Groups	1	1519.70	1519.70	94.05*
Within Groups	23	371.66	16.16	

Pearson r = .90*; Full range correlation = .36*
* p < .05

Test	Group	Mean	Standard Deviation	N
ACT Composition	LS	10.06	3.26	16
	HS	25.78	2.95	9

Source	df	SS	MS	F
Between Groups	1	1422.55	1422.55	143.19*
Within Groups	23	228.49	9.93	

Pearson r = .92*, Full range correlation = .48*
* p < .05

Table 20

A comparison of Scholastic Aptitude Test Scores Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Test	Group	Mean	Standard Deviation	N
SAT Verbal	LS	298.33	54.95	6
	HS	480.00	71.36	12

Source	df	SS	MS	F
Between Groups	1	132132.25	132132.25	22.95*
Within Groups	16	92104.25	5756.52	

Pearson r = .77*; Full range correlation = .28*
* p < .05

Test	Group	Mean	Standard Deviation	N
SAT Mathematics	LS	316.67	46.76	6
	HS	576.33	51.78	12

Source	df	SS	MS	F
Between Groups	1	269707.11	269707.11	106.74*
Within Groups	16	40428.00	2526.75	

Pearson r = .93*, Full range correlation = .39*
* p < .05

Test	Group	Mean	Standard Deviation	N
SAT Composition	LS	515.00	118.20	6
	HS	1056.42	76.20	12

Source	df	SS	MS	F
Between Groups	1	779394.70	779394.69	93.10*
Within Groups	16	133824.92	8364.06	

Pearson r = .92*, Full range correlation = .38*
* p < .05

Table 21

A Summary of Placement Test Mean Scores by Group with F Value

Test	Group	Mean	N	F Value
ACT English	LS	11.75	16	64.44*
	HS	23.22	9	
ACT Mathematics	LS	6.50	16	99.12*
	HS	26.78	9	
ACT Sociology	LS	9.37	16	66.24*
	HS	24.00	9	
ACT Natural Science	LS	12.31	16	94.85*
	HS	28.56	9	
ACT Composition	LS	10.06	16	143.19*
	HS	25.70	9	
SAT Verbal	LS	290.33	6	22.95*
	HS	400.00	12	
SAT Mathematics	LS	316.67	6	106.74*
	HS	576.33	12	
SAT Composition	LS	515.00	6	93.10*
	HS	1056.42	12	

* $p < .05$

As a result, the third hypothesis--that there are no significant differences in placement test scores between students who performed well and those who performed poorly on the computational skills of the CLAST--was rejected. Students who performed well on the computational skills of the CLAST scored significantly higher on each ACT and SAT placement test than those students who performed poorly on the computational skills of the CLAST.

The fourth hypothesis stated that there are no significant differences in performance on the reading, writing, or essay subtests of the CLAST between students who performed well and students who performed poorly on the computational skills of the CLAST. Since data which pertain to this hypothesis were available for all 56 students in the study, they were analyzed by multiple analysis of variance with other variables available for all 56 student. Summaries of these data are presented in Table 3 on page 53 of this dissertation. The multivariate F of 13.95 was significant at the $p < .05$ level. When the univariate F tests were applied, the values for CLAST reading, CLAST writing, and CLAST essay of 44.77, 51.58, and 21.02 respectively were all significant at the .05 level. Pearson r correlations for reading (.67), writing (.70), and essay (.53) were also all significant. Full range correlations for reading (.23) and writing (.25) were significant ($p < .05$); but the correlation was not significant for essay (.17).

Therefore, the fourth hypothesis--that there are no significant differences in performance on the reading, writing, or essay subtests of the CLAST between students who performed well and students who performed poorly on the computational skills of the CLAST--was rejected. Students who performed well on the computational skills of the CLAST also scored significantly higher on the writing, reading, and essay subtests of the CLAST.

Research Question #3:
Comparison of Groups by Academic Preparation

The third research question concerned whether or not there were significant differences in academic preparation between high scoring and low scoring groups. The fifth null hypothesis stated that there are no significant differences in high school academic preparation between students who performed well and students who performed poorly on the computational skills of the CLAST.

For students whose transcripts were available, high school grade point average, high school mathematics grade point average, and number of semesters of high school mathematics were analyzed by a multiple analysis of variance (see Table 22). These variables resulted in a multivariate F value of 15.24, significant for $p < .05$. The grade point average for high scoring students was 3.20, compared with 2.41 for low scoring students. The univariate F value was 26.05, the Pearson r for high school grade point average was .64, and the full range correlation was .22, all significant at the .05 level. The difference in high school mathematics grade point average for the groups was even more pronounced, with 3.13 for the high scoring group as compared to 1.98 for the low scoring group. For this variable, the univariate F was 39.44, the Pearson r was .76, and the full range correlation was .29, again all significant. Finally, students in the high scoring group had completed almost twice as many semesters of mathematics as those in the lower group, averaging 7.1 semesters compared to 4.3.

Table 22

A Comparison High School GPA, Semesters of High School Mathematics, and High School Mathematics GPA of Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Variable	Group	Mean	Standard Deviation	Univariate F Value	p
High School GPA	LS HS	2.41 3.20	.44 .56	20.05	.000*
Semesters High School Mathematics	LS HS	4.30 7.09	1.75 1.53	30.96	.000*
High School Mathematics GPA	LS HS	1.88 3.13	.51 .75	39.44	.000*

Multivariate F = 15.24; df = 1, 54; p = .000*
HS (n=23); LS (n=20)
* $p < .05$

Univariate F test (30.96), Pearson correlation (.76), and full range correlation (.20) were all significant for $p < .05$.

Two variables, highest high school mathematics course and high school curriculum, were studied using a chi-square analysis. In studying highest high school mathematics course (see Table 23), it was observed that 20 of the 23 high scoring students had completed Algebra II or above, compared to only 2 of the 20 low scoring students. Algebra I or below was the highest mathematics course for only 1 of the 23 high scoring students, compared with 15 of the 20 low scoring students. A chi-square value of 29.39 was obtained with a Kendell correlation of .49, both

Table 23

A Comparison of Highest High School Mathematics Course Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	Bus Math	Gen Math	Pre Alg	Alg 1	Geom
LS	4	2	2	7	3
HS	0	0	0	1	2
Column Total	4	2	2	8	5

Group	Alg II	Trig	Anal Geom	Calc
LS	2	0	0	0
HS	6	6	5	3
Column Total	8	6	5	3

Chi-square = 29.39; df = 8; p = .000*
Kendall's Tau B = .4854; p = .000*
Full range correlation = .1571
HS (n=23); LS (n=20)
* p < .05

significant for p < .05. The full range correlation of .16 was not significant, however.

One effect of tracking from high school curriculum is demonstrated in Table 24. It was observed that 17 of the 22 (77.3%) high scoring students had completed a college preparatory track, compared to 6 of the 17 (35.3%) low scoring students. By contrast, only 3 of 22 (13.6%) high scoring students had completed a general track, compared to 8 of the 17 (47.1%) low scoring students. This analysis

Table 24

A Comparison of High School Curriculum Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	Not Tracked	General	Vocation	College Prep	Row Total
LS	2	8	1	6	17
HS	0	3	2	17	22
Column Total	2	11	3	23	39

Chi-square = 9.38; df = 3; $p = .0246$*
* $p < .05$

resulted in a chi-square value of 9.38, significant at the .05 level.

The fifth null hypothesis--that there are no significant differences in high school academic preparation between students who performed well and students who performed poorly on the computational skills of the CLAST--was rejected. Students in the high scoring group had significantly higher high school grade point averages and mathematics grade point averages, and they enrolled in more high school mathematics classes and at higher levels than students from the low scoring group.

The sixth hypothesis stated that there are no significant differences in college academic preparation between students who performed well and students who performed poorly on the computational skills of the CLAST. A multiple analysis of variables (Table 25) was performed on the variables total college credits, number of courses

Table 25

A Comparison of Total College Credits, Community College GPA, Number of Mathematics Courses Intermediate Algebra or Higher, College Mathematics GPA, Number of Courses Withdrawn or Audited, and Number of Mathematics Courses Withdrawn or Audited of Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Variable	Group	Mean	Standard Deviation	Univariate F Value	p
Total College Credits	LS HS	70.07 77.00	0.77 20.59	2.67	.100
Community College GPA	LS HS	2.63 3.52	.42 .43	61.90	.000*
Number of Mathematics Courses, Int Alg or Higher	LS HS	1.93 3.93	.86 1.66	31.69	.000*
College Mathematics GPA	LS HS	2.29 3.25	.65 .65	29.54	.000*
Number of Courses Withdrawn	LS HS	4.36 3.11	3.35 4.05	1.55	.210
Number of Mathematics Courses Withdrawn	LS HS	2.10 .70	1.70 1.10	14.44	.000*

Multivariate F = 12.47; df = 1, 53; p = .000*
HS (n=27); LS (n=28)
* $p < .05$

withdrawn or audited, and community college grade point average, together with certain variables related to mathematics course background. Those variables which directly involve college courses in mathematics will be discussed with the seventh null hypothesis. The multivariate F was significant at 12.47, but according to the univariate tests that followed, total college credits and number of courses withdrawn or audited were not significant for $p < .05$. However, community college grade point average, 3.52 average for high scoring students compared with 2.63 average for low scoring students, was significantly different for the groups with a univariate F value of 61.98. The Pearson r (.74) and the full range correlation (.27) were also significant at the .05 level.

It was observed that more high scoring students earned an associate degree than low scoring students. In Table 26 it can be seen that 24 (85.7%) high scoring students completed this degree, compared to 18 (64.3%) low scoring students. However, with a chi-square value after Yates Correction of 2.38, the difference was not significant at the .05 level.

Therefore, the sixth hypothesis--that there are no significant differences in college academic preparation between students who performed well and students who

Table 26

A Comparison of Completion of Associate Degree Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	No	Yes	Row Total
LS	10	18	28
HS	4	24	28
Column Total	14	42	56

Chi-square after Yates Correction = 2.38; df = 1; p = .1228
Kendall's Tau B = .2474; p = .0333*
* $p < .05$

performed poorly on the computational skills of the CLAST--was partially rejected because of the analysis related to GPA. The only significant difference was that students who performed well on the computations skills of the CLAST also earned higher grade point averages. Total number of credits, number of withdrawals and audits, and graduation from the community college were not significant for $p < .05$.

The seventh null hypothesis stated that there are no significant differences in college mathematics preparation between students who performed well and students who performed poorly on the computational skills of the CLAST. A multiple analysis of variance was applied to the number of mathematics courses taken, number of mathematics courses withdrawn or audited, and college mathematics grade point average, together with other variables pertaining to overall college academic background. The findings of this analysis are presented in Table 25 on page 74. The average number of mathematics courses taken by high scoring students was 3.93, compared to 1.93 for low scoring students. The univariate F for number of mathematics courses was 31.69, and the Pearson r was .56, both significant at the .05 level. However, the full range correlation (.19) was not significant. High scoring students had withdrawn or audited an average of .70 mathematics courses, compared to 2.10 for low scoring students. The F value of 14.44 and Pearson r of.47 were both significant at the .05 level, but the full range correlation (.15) was not significant. The mathematics grade point average, 3.25 for high scoring students and 2.29 for low scoring students, resulted in an F score of 29.54, a Pearson r of .64, and a full range correlation of .20, all significant for $p < .05$.

The number of enrollments in developmental mathematics was examined by chi-square analysis, with the results presented in Table 27. It was determined that 22 of the 28 (78.6%) low scoring students enrolled in one or more developmental mathematics courses. This compares to 3 of the 28 (13.5%) high scoring students who enrolled in one or more such courses. The difference was significant at the .05 level for the chi-square value (26.09), the Kendall correlation (-.63), and also the full range correlation (-.21).

The proportion of low scoring students with credit in Finite Mathematics (50%) was also significantly higher than

Table 27

A Comparison of Number of Enrollments in Developmental Mathematics Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	0	1	2	Row Total
LS	6	14	8	28
HS	25	2	1	28
Column Total	31	16	9	56

Chi-square = 26.09; df = 2; p = .0000*
Kendall's Tau B = -.6291; p = .0000*
Full range correlation = -.2149*
* $p < .05$

it was for high scoring students (17.9%). The chi-square value after Yates Correction was 5.10, with the Kendall correlation of -.34, both significant for $p < .05$, as shown in Table 28. The full range correlation (.11) was not significant. While it was significant that more low scoring students enrolled in Finite Mathematics, it was also significant that high scoring students earned higher grades in this course. The average grade in Finite Mathematics for high scoring students (3.40 on a four-point scale) was compared with that of low scoring students (1.50) in a one-way analysis of variance (Table 29). The F value (17.82) and the Pearson correlation (.72) were both significant, but the full range correlation (.25) was not significant at the .05 level.

Table 28

A Comparison of Finite Mathematics Credit Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	No	Yes	Row Total
LS	14	14	28
HS	23	5	28
Column Total	37	19	56

Chi-square after Yates Correction = 5.10, df = 1; $p = .0240$*
Kendall's Tau B = -.3394; $p = .0059$*
Full range correlation = -.1059
* $p < .05$

Table 29

A Comparison of the Grade in Finite Mathematics Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	Mean	Standard Deviation	N
LS	1.50	.85	14
HS	3.40	.89	5

Source	df	SS	MS	F
Between Groups	1	13.30	13.30	17.80*
Within Groups	17	12.70	.75	

* $p < .05$

Finally, there was a significant difference in the highest college mathematics credit earned by high scoring students compared with low scoring students. As seen in Table 30, 18 of 28 (64.3%) of the high scoring students completed a course higher than College Algebra, while 3 of 28 (10.7%) of the low scoring students completed a course higher than College Algebra. The chi-square value (28.23) and the Kendall correlation (.41) were significant, but the full range correlation (.13) was not significant for $p < .05$.

Consequently, the seventh hypothesis--that there are no significant differences in college mathematics preparation between students who performed well and students who performed poorly on the computational skills of the CLAST--was rejected. High scoring students completed twice as many mathematics courses at the level of Intermediate Algebra or above and earned significantly higher grades in mathematics courses. Low scoring students had withdrawn from or audited mathematics courses three times as frequently as high scoring students. Low scoring students also enrolled more frequently in developmental mathematics courses and in Finite Mathematics, but high scoring students who did enroll in Finite Mathematics earned significantly higher grades.

Table 30

A Comparison of Highest College Mathematics Credit Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	None	Basic Alg	Int Alg	Finite Math	Statistics	Coll Alg
LS	1	1	3	11	2	7
HS	1	0	0	2	0	7
Column Total	2	1	3	13	2	14

Group	Trig	Bus Calc	Calc I	Calc III	Diff Eq
LS	1	0	2	0	0
HS	3	2	2	4	7
Column Total	4	2	4	4	7

Chi-square = 28.23; df = 10; p = .0030*
Kendall's Tau B = .4079; p = .0003*
Full range correlation = .1292
HS (n=28); LS (n=28)
* $p < .05$

The eighth null hypothesis stated that there are no significant differences in preparation for the CLAST or perceived difficulty with the CLAST between students who performed well and students who performed poorly on the computational skills of the CLAST. A comparison of strategies to prepare for the CLAST by high scoring students compared to those of low scoring students is presented in Table 31. The chi-square value of 14.97 was not significant at the .05 level. The most frequently mentioned strategy

Table 31

A Comparison of Strategies in Preparation for CLAST Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	CLAST Review Prac CLAST	Finite Math	Math Lab Mater	Assess Center	Course work only	CLAST Review Finite Math
LS	7	0	0	1	3	1
HS	7	1	2	2	5	0
Column Total	14	1	2	3	8	1

Group	Finite Math Alg	CLAST Review Subj Sess	Prac CLAST Finite Math	Prac CLAST Course work	CLAST Review Statis Alg	CLAST Review Alg
LS	1	0	2	0	0	1
HS	1	1	3	1	1	0
Column Total	2	1	5	1	1	1

Group	Math Lab Subj Sess	Prac CLAST Finite Alg	Prac CLAST CLAST book	Old Campus Math Lab	Finite Math Subj Sess	CLAST Review Special Service
LS	1	1	1	1	1	1
HS	0	0	0	0	0	0
Column Total	1	1	1	1	1	1

Chi-square = 14.97, df = 17; p = .5973
HS (n=24), LS (n=22)

was enrollment in IDS 1109 CLAST Review and the use of the Practice CLAST. No significant differences between high and low scoring students were observed in a separate chi-square comparison of credit in IDS 1109 (Table 32).

A chi-square analysis of perceived preparation for the CLAST generally and for the computations subtest of the CLAST in particular are illustrated in Tables 33 and 34. While there were no significant differences in perceived preparation for the CLAST generally (chi-square value of .30), the perceived preparation for the computations subtest of the CLAST was significantly higher for high scoring students. The chi-square value of 12.07 and Kendall correlation of .57 were both significant at the .05 level, but the full range correlation of .19 was not significant.

Table 32

A Comparison of Credit in IDS 1109 (CLAST Review) Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	No	Yes	Row Total
LS	15	13	20
HS	19	9	28
Column Total	34	22	56

Chi-square after Yates Correction - .67; df = 1; p = .4117
Kendall's Tau B = -.1462; p = .1390

Table 33

A Comparison of Perceived Preparation for CLAST Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	No	Yes	Row Total
LS	3	19	22
HS	1	23	24
Column Total	4	42	46

Chi-square after Yates Correction = .38; df = 1; p = .5387
Kendall's Tau B = .1679; p = .1300

Table 34

A Comparison of Perceived Preparation for CLAST Computations Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	No	Yes	Row Total
LS	10	11	21
HS	0	24	24
Column Total	10	35	45

Chi-square after Yates Correction = 12.07; df = 1; p =.0005*
Kendall's Tau B = .5714; p = .0001*
Full range correlation = .1906
* $p < .05$

Finally, perceived areas of difficulty were determined for the CLAST generally (Table 35) and for the computations subtest of the CLAST in particular (Table 36). Significant differences were observed between high scoring and low scoring students for both of these variables. Comparing perceived difficulty with the CLAST in general, 14 of 24 (58.3%) high scoring students perceived no parts of the test difficult, compared with 3 of 22 (13.6%) low scoring students. Also, none of the 24 (0.0%) high scoring students perceived difficulty with the computations subtest, compared with 17 of 22 (77.3%) low scoring students. Most of these students scoring at the extremes of the CLAST Computations were aware of their situations. However, 10 of the 24 (41.7%) high scoring students cited the reading, writing, or essay subtests of the CLAST or a combination of these as being difficult, compared with only 2 of 22 (9.1%) low scoring students. The chi-square value of 32.09 was significant for $p < .05$.

The perceived difficulty with certain skill areas of the computations subtest of the CLAST are reported in Table 36. The differences were significant for $p < .05$ with a chi-square value of 28.53. Of the 24 high scoring students, 9 (37.5%) perceived no area of difficulty, compared with 3 of 21 (9.5%). Also, 5 of 24 (20.8%) high scoring students compared with 9 of 21 (42.9%) low scoring students perceived difficulty with the geometric items on the test.

Table 35

A Comparison of Areas of CLAST Perceived To Be Difficult Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	None	Comp	Read	Essay	Read Essay	Row Total
LS	3	17	0	2	0	22
HS	14	0	5	2	3	24
Column Total	17	17	5	7	6	46

Chi-square = 32.09; df = 4; p = .0000*
* p < .05

Table 36

A Comparison of Areas of CLAST Computations Perceived To Be Difficult Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	None	Logic	Geom	P & S	Logic P & S	Logic P & S Geom	P & S Geom	Alg Geom	Row Total
LS	3	1	6	2	3	1	2	0	21
HS	9	1	1	2	0	2	1	1	24
Column Total	12	2	7	4	3	3	3	1	45

Chi-square = 28.53; df = 7, p = .0002*
* p < .05

Therefore, the eighth hypothesis--that there are no significant differences in preparation for the CLAST or perceived difficulty with the CLAST between students who performed well and students who performed poorly on the computational skills of the CLAST--was partially rejected. While differences in preparation strategies for the CLAST were not significant for high and low scoring students, low scoring students perceived greater difficulty with the computational skills of the CLAST generally and with the geometric test items specifically. High scoring students perceived little difficulty with the computational skills but more difficulty with the reading, writing, and essay subtests of the CLAST.

Research Question #4
Comparison of Groups by Affective Characteristics

The fourth research question was concerned with whether or not there were significant differences in affective characteristics between high scoring and low scoring groups. The ninth null hypothesis stated that there are no significant differences in cognitive styles between students who performed well and students who performed poorly on the computational skills of the CLAST.

The results of the multiple analysis of variance performed on scores obtained from the Style Delineator by Gregorc together with scores obtained from the Mathematics Anxiety Rating Scale are presented in Table 37. Using the Gregorc instrument, four dimensions of cognitive style were

Table 37

A Comparison of Mathematics Anxiety Rating Scale Scores and Gregorc Learning Style Scores of Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Variable	Group	Mean	Standard Deviation	Univariate F Value	p
Mathematics Anxiety Rating Scale	LS	208.27	54.03		
	HS	165.29	42.14	9.13	.004*
Mathematics Anxiety Rating Scale Subtest	LS	55.59	17.00		
	HS	40.67	15.00	9.46	.004*
Mathematics Anxiety Rating Scale (Test Anxiety)	LS	31.77	10.52		
	HS	22.30	8.65	11.03	.002*
Concrete/ Sequential	LS	24.14	4.53		
	HS	27.50	4.62	6.51	.014*
Abstract/ Sequential	LS	23.14	4.45		
	HS	23.62	3.89	.16	.693
Abstract/ Random	LS	26.91	4.40		
	HS	23.71	4.24	6.20	.017*
Concrete/ Random	LS	26.05	4.36		
	HS	25.00	4.02	.59	.446

Multivariate F = 2.03; df = 1, 44, p = .060
HS (n=24); LS (n=22)
* p < .05

assessed: concrete/sequential (CS), abstract/sequential (AS), abstract/random (AR), and concrete/random (CR). The multivariate F value for this MANOVA was 2.03, not significant at the .05 level. However, the univariate F values for CS and AR, 6.51 and 6.20 respectively, were significant for p < .05, with high scoring students higher in the concrete/sequential preference and low scoring students higher in the abstract/random preference. Univariate F values for AS and CR, .16 and .59 respectively, were not significant. This test was followed by a chi-square analysis of preferred learning style (Table 38), which yielded no significant differences for p < .05.

Chi-square analysis followed by Yates Correction was performed on the seven questions (see Appendix E) designed to compare field-dependence/independence preferences between high scoring and low scoring students. The results of this analysis are presented in Table 39. No significant differences resulted from the chi-square analysis, and only the question related to thinking skills was observed to have a significant correlation at the .05 level. This question was designed to determine the students' preference for breaking a situation into its parts (field-independent) as opposed to viewing the situation globally (field-dependent). Whereas 19 of the 24 (79.2%) high scoring students preferred breaking the situation down into its parts, 11 of the 22 (50%) low scoring students selected this choice.

Therefore, the ninth hypothesis--that there are no significant differences in cognitive styles between students who performed well and students who performed poorly on the computational skills of the CLAST--was partially rejected. High scoring students demonstrated significantly higher scores for the abstract/sequential learning style, while low

Table 30

A Comparison of Learning Style Preference Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	No Pref	CS	AS	AR	CR	Row Total
LS	0	5	2	10	5	22
HS	2	10	3	4	5	24
Column Total	2	15	5	14	10	46

Chi-square = 6.36; df = 4; p = .1736

Table 39

A Comparison of Field-Dependence/Independence Preferences Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

	DEPENDENT	INDEPENDENT	
Task Oriented	Easily distracted	Concentrates easily	Row Total
LS	10	12	22
HS	6	18	24
Column Total	16	30	46

Chi-square after Yates Correction = 1.31; df = 1, p = .2521
Kendall's Tau B = .2145; p = .0751

Table 39--Continued

Learning Environment	Prefers lecture	Prefers self-study	Row Total
LS	12	10	22
HS	17	7	24
Column Total	29	17	46

Chi-square after Yates Correction = .70; df = 1; p = .4023
Kendall's Tau B = -.1686; p = .1291

Problem Solving	Broad, apply diff ideas	Specific probs, skills	Row Total
LS	10	12	22
HS	11	13	24
Column Total	21	25	46

Chi-square after Yates Correction = .00; df = 1; p = 1.0000
Kendall's Tau B = -.0038; p = .4898

Work Habits	Prefers partner	Prefers solo	Row Total
LS	9	13	22
HS	10	14	24
Column Total	19	27	46

Chi-square after Yates Correction = .00; df = 1; p = 1.000
Kendall's Tau B = -.0077; p = .4794

Table 39--Continued

Thinking Skills	Views the whole	Breaks down into parts	Row Total
LS	11	11	22
HS	5	19	24
Column Total	16	26	46

Chi-square after Yates Correction = 3.11; df = 1; p = .0776
Kendall's Tau B = .3059; p = .0201*
* p < .05

Test Taking	Prefers essay test	Specific, short answer	Row Total
LS	14	6	22
HS	12	12	24
Column Total	26	20	46

Chi-square after Yates Correction = .40; df = 1; p = .5259
Kendall's Tau B = .1374; p = .1783

	No right or wrong answers	Definite answers	Row Total
LS	9	13	22
HS	8	16	24
Column Total	17	29	46

Chi-square after Yates Correction = .05; df = 1; p = .8212
Kendall's Tau B = .0784; p = .2995

scoring students demonstrated significantly higher scores for the abstract/random learning style. However, in a categorical analysis of learning style preference, the differences were not significant. Differences related to field-dependence/independence were also non-significant.

The 10th null hypothesis stated that there are no significant differences in recall of experiences or role models in mathematics between students who performed well and students who performed poorly on the computational skills of the CLAST. The comparison of mathematics memories is shown in Table 40. While 10 of the 22 (45.5%) low scoring students reported negative memories and 3 (13.6%) reported positive memories, 5 of the 24 (20.8%) high scoring students reported negative memories, and 15 (62.5%) reported positive memories. This resulted in a chi-square value of 11.52, and Kendall correlation of .42, both significant for $p < .05$. The full range correlation of .13 was not significant.

The findings of chi-square analyses for role models in adolescence, high school, and college are presented in Tables 41 through 43, respectively. None of these variables was significant for $p < .05$, with chi-square values of 1.03, 4.63, and 5.21 respectively. Of these variables, only the correlation for high school role models (.28) was significant at the .05 level.

Table 40

A Comparison of Mathematics Memories Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	Negative	Neutral	Positive	Row Total
LS	10	9	3	22
HS	5	4	15	24
Column Total	15	13	18	46

Chi-square = 11.52; df = 2; p = .0031*
Kendall's Tau B = .4164; p = .0015*
Full range correlation = .1322
* p < .05

Table 41

A Comparison of Childhood/Adolescent Role Models Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	Negative	Neutral	Positive	Row Total
LS	2	4	16	22
HS	2	2	20	24
Column Total	4	6	36	46

Chi-square = 1.03; df = 2; p = .5987
Kendall's Tau B = .1155; p = .2135

Table 42

A Comparison of High School Role Models Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	Negative	Neutral	Positive	Row Total
LS	10	5	7	22
HS	4	7	13	24
Column Total	14	12	20	46

Chi-square = 4.63; df = 1; p = .0989
Kendall's Tau B = .2707; p = .0240*
* p < .05

Table 43

A Comparison of College Role Models Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	Negative	Neutral	Positive	Row Total
LS	4	5	13	22
HS	0	9	15	24
Column Total	4	14	28	46

Chi-square = 5.21; df = 1, p = .0740
Kendall's Tau B - .0993; p = .2459

The 10th hypothesis--that there are no significant differences in recall of experiences or role models in mathematics between students who performed well and students who performed poorly on the computational skills of the CLAST--was partially rejected. Significantly more students from the low scoring group had negative memories of mathematics, and less had positive memories than did students from the high scoring group. There were no significant differences in role models at the .05 level.

The 11th null hypothesis stated that there are no significant differences in personality type between students who performed well and students who performed poorly on the computational skills of the CLAST. While high scoring students were more frequently extraverted, intuitive, and thinking types, the differences in personality type between high scoring and low scoring students were not significant at the .05 level. The chi-square analysis is presented in Table 44.

Therefore, the 11th hypothesis--that there are no significant differences in personality types between students who performed well and students who performed poorly on the computational skills of the CLAST--was not rejected. Although those in the high scoring group appeared somewhat more introverted and more intuitive with a slight preference toward thinking rather than feeling than those in the low scoring group, the differences were not significant at the .05 level.

Table 44

A Comparison of Personality Type Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	Extraversion	Introversion	Row Total
LS	15	7	22
HS	14	10	24
Column Total	29	17	46

Chi-square after Yates Correction = .15 ; df = 1; p = .6999
Kendall's Tau B = .1019; p = .2471

Group	Intuition	Sensation	Row Total
LS	9	13	22
HS	14	10	24
Column Total	23	23	46

Chi-square after Yates Correction = .70; df = 1; p = .3750
Kendall's Tau B = -.1741; p = .1215

Group	Thinking	Feeling	Row Total
LS	10	12	22
HS	13	11	24
Column Total	23	23	46

Chi-square after Yates Correction = .09; df = 1; p = .7679
Kendall's Tau B = -.0870, p = .2797

Table 44--Continued

Group	Judging	Perceiving	Row Total
LS	15	7	22
HS	15	9	24
Column Total	30	16	46

Chi-square after Yates Correction = .01; df = 1; p = .9249
Kendall's Tau B = .0596; p = .3447

The 12th null hypothesis stated that there are no significant differences in attitudes of students toward mathematics or testing between students who performed well and students who performed poorly on the computational skills of the CLAST. Scores from the Mathematics Anxiety Rating Scale (MARS) for high scoring students and low scoring students were compared using a multiple analysis of variance. The results of this analysis were presented in Table 37 on page 88. The mean scores for high and low scoring groups were 165.3 and 208.3 respectively. The univariate F value 9.13 was significant for $p < .05$. Scores for a subset of questions from the MARS that specifically relate to mathematics in the community college were also compared for both groups, with univariate F value of 9.46, significant at the .05 level. Comparison of scores for questions from the MARS relating directly to test anxiety resulted in a significant F value of 11.03.

Students' attitudes toward multiple choice tests were compared using a chi-square analysis (Table 45). While low scoring students were slightly more positive about multiple choice tests than high scoring students, the chi-square value of 2.37 and Kendall correlation of -.15 were both non-significant at the .05 level.

Therefore the 12th hypothesis--that there are no significant differences in attitudes of students toward mathematics or testing between students who performed well and students who performed poorly on the computational skills of the CLAST--was rejected in terms of attitudes toward mathematics. While there were no significant differences in attitudes of students toward multiple choice tests, students with lower scores on the CLAST reported significantly higher mathematics and test anxiety.

The 13th null hypothesis stated that there are no significant differences in attitudes of students toward college or toward the CLAST between students who performed well and students who performed poorly on the computational skills of the CLAST. Comparison of student attitudes toward the CLAST by use of chi-square analysis is shown in Table 46. Attitudes of high scoring students were slightly more positive than those of low scoring students, but the results, with chi-square value of 1.33 and Kendall correlation of .16, were not significant for $p < .05$.

Attitudes of students toward the community college (Table 47) with only one exception were positive for all

Table 45

A Comparison of Attitude Toward Multiple Choice Exams Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	Negative	Neutral	Positive	Row Total
LS	5	6	11	22
HS	6	11	7	24
Column Total	11	17	18	46

Chi-square = 2.37, df = 1; p = .3061
Kendall's Tau B = -.1507, p = .1426

Table 46

A Comparison of Attitude Toward CLAST Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	Negative	Neutral	Positive	Row Total
LS	3	8	11	22
HS	2	6	16	24
Column Total	5	14	27	46

Chi-square = 1.33; df = 2; p = .5150
Kendall's Tau B = .1622; p = .1295

Table 47

A Comparison of Attitude Toward the Community College Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	Neutral	Positive	Row Total
LS	0	22	22
HS	1	23	24
Column Total	1	45	46

Chi-square after Yates Correction = .00; df = 1; p = 1.000
Kendall's Tau B = -.1427; p = .1602

students interviewed. The chi-square value (.88) and Kendall correlation (-.14) were both non-significant at the .05 level. Similarly, the differences between high and low scoring students in motivations for attending college (Table 48) and in motivations for attending the community college (Table 49), with chi-square values of 9.16 and 22.19 respectively, were not significant.

Table 48

A Comparison of Motivation for Attending College Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	Career Degree	Personal Improv	Better Life	Child Amb	Parents
LS	9	2	4	2	0
HS	13	1	0	1	1
Column Total	22	3	4	3	1

Group	Get Away	Career Personal Improv	Parents Career	Career Child Amb
LS	1	3	1	0
HS	0	5	2	1
Column Total	1	8	3	1

Chi-square = 9.16; df = 8; p = .2292
HS (n=24); LS (n=22)

Table 49

A Comparison of Motivation for Attending the Community College Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	Close	Cost	Step Stone	GPA Open Door	AA Deg	Atmos	Scholarship	Parents
LS	3	1	6	2	3	1	2	0
HS	9	1	1	2	0	2	1	1
Column Total	12	2	7	4	3	3	3	1

Group	Close Cost	Cost Step Stone	Close Cost Atmos	Cost Small School	Close Cost GPA	Close Atmos	Close AA Deg
LS	0	0	0	0	1	2	1
HS	2	3	1	1	0	0	0
Column Total	2	3	1	1	1	2	1

Chi-square = 22.19; df = 14; p = .0747
HS (n=24); LS (n=22)

The 13th hypothesis--that there are no significant differences in attitudes of students toward college or toward the CLAST between students who performed well and students who performed poorly on the computational skills of the CLAST--was not rejected. High scoring students were slightly more positive in their attitudes toward the CLAST, but not significantly so. Attitudes toward the community college, as well as motivations for attending college in general and community college specifically, were not significantly different.

The 14th and last hypothesis stated that there are no significant differences in perceived attitudes of parents between students who performed well and those who performed poorly on the computational skills of the CLAST. Tables 50 through 52 show the results of chi-square analyses of perceived parent attitudes toward mathematics, toward exams, and toward college respectively. There were no significant differences between reported attitudes of parents of low scoring students and those of high scoring students, with chi-square values of 0.35, 1.50, and 1.16 respectively. Therefore, the 14th and last hypothesis--that there are no significant differences in perceived attitudes of parents between students who performed well and those who performed poorly on the computational skills of the CLAST--was not rejected.

Table 50

A Comparison of Perceived Parent Attitudes Toward Mathematics Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	Negative	Neutral	Positive	Row Total
LS	3	10	9	22
HS	2	12	10	24
Column Total	5	22	19	46

Chi-square = .35; df = 2; p = .8402
Kendall's Tau B = .0349; p = .4040

Table 51

A Comparison of Perceived Parent Attitudes Toward Exams Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	Negative	Neutral	Positive	Row Total
LS	1	8	13	22
HS	1	13	10	24
Column Total	2	21	23	46

Chi-square = 1.50; df = 2; p = .4729
Kendall's Tau B = -.1504; p = .1394

Table 52

A Comparison of Perceived Parent Attitudes Toward College Between Students with High Scores (HS) and Students with Low Scores (LS) on the Computations Subtest of the CLAST

Group	Negative	Neutral	Positive	Row Total
LS	1	4	17	22
HS	2	2	20	24
Column Total	3	6	37	46

Chi-square = 1.16; df = 2; p = .5603
Kendall's Tau B = .0684; p = .3395

Summary

Significant F values, correlations, and full range correlations for comparisons of high scoring and low scoring groups are summarized in Table 53. Among the demographic variables, only race and parents' education were significant. Career plans, placement test scores, other CLAST scores, high school background, college grade point average, college mathematics background, and attitudes toward mathematics were all areas in which the variables studied were observed to be significantly different. Significant differences were also observed in the concrete/sequential learning style, preferred by the high scoring group, and abstract/random learning style, preferred by the low scoring group. Areas in which significant differences were not observed included age, sex, citizenship, family income, parents' occupation, employment and enrollment status, total college credits or withdrawals, associate of arts degree, CLAST preparation strategies, field-dependence/independence, role models, personality type, attitude toward college, attitude toward CLAST, and perceived parents attitudes.

Fourteen hypotheses were tested in this study. Three of these hypotheses were not rejected because there were no significant differences in any of the variables considered. Seven of the hypotheses were rejected in part because one or more of the variables resulted in significant differences. Four hypotheses were rejected completely for all variables.

Table 53

Summary of Findings

Variable	F Value	Correlation	Full Range
Age	Not sig	Not sig	Not sig
Sex	Not sig	*	Not sig
Race	*	N/A	N/A
Citizenship	Not sig	*	Not sig
Family Income	Not sig	*	Not Sig
Father's Education	*	*	Not sig
Mother's Education	*	*	Not sig
Father's Occupation	Not sig	N/A	N/A
Mother's Occupation	Not sig	N/A	N/A
Credit Hours Sem CLAST	Not sig	Not sig	Not sig
Work Hours Sem CLAST	Not sig	Not sig	Not sig
Work Experience	Not sig	Not sig	Not sig
Current Enrollment	Not sig	*	Not sig
Where Enrolled	Not sig	N/A	N/A
Major	Not sig	N/A	N/A
Career Plans	*	N/A	N/A
ACT English	*	*	*
ACT Mathematics	*	*	*
ACT Sociology	*	*	*
ACT Natural Science	*	*	*
ACT Composition	*	*	*
SAT Verbal	*	*	*
SAT Mathematics	*	*	*
SAT Composition	*	*	*
CLAST Reading	*	*	*
CLAST Writing	*	*	*
CLAST Essay	*	*	Not sig
High School GPA	*	*	*
Sem HS Mathematics	*	*	*
HS Mathematics GPA	*	*	*
Highest HS Mathematics	*	*	Not sig
HS Curriculum	*	N/A	N/A
Total College Credits	Not sig	Not sig	Not sig
Community College GPA	*	*	*
No. Courses Withdrawn	Not sig	Not sig	Not sig
Associate Degree	Not sig	*	Not sig
Math Courses Int Alg/Above	*	*	Not sig
College Mathematics GPA	*	*	*
No. Math Courses Withdrawn	*	*	Not sig
No. Devel Math Courses	*	*	*
Finite Mathematics Credit	*	*	Not sig
Finite Mathematics Grade	*	*	Not sig
Highest Coll Mathematics	*	*	Not sig

* $p < .05$

Table 53--Continued

Variable	F Value	Correlation	Full Range
CLAST Prep Strategies	Not sig	N/A	N/A
CLAST Review (IDS 1109)	Not sig	N/A	N/A
Perceived Prep for CLAST	Not sig	Not sig	Not sig
Perc Prep for CLAST Comp	*	*	Not sig
CLAST Difficulty Areas	*	N/A	N/A
CLAST Comp Diff Areas	*	N/A	N/A
Learning Style Preference	Not sig	N/A	N/A
Concrete/Sequential	*	*	Not sig
Abstract/Sequential	Not sig	Not sig	Not sig
Abstract/Random	*	*	Not sig
Concrete/Random	Not sig	Not sig	Not sig
Concentrates/Distracted	Not sig	Not sig	Not sig
Lecture/Self Study	Not sig	Not sig	Not sig
Broad/Specific Skills	Not sig	Not sig	Not sig
Partner/Solo	Not sig	Not sig	Not sig
Whole/Parts	Not sig	*	Not sig
Essay/Short Answer Test	Not sig	Not sig	Not sig
Definite/No Definite Ans	Not sig	Not sig	Not sig
Mathematics Memories	*	*	Not sig
Child/Adoles Role Models	Not sig	Not sig	Not sig
High School Role Models	Not sig	*	Not sig
College Role Models	Not sig	Not sig	Not sig
Extraversion/Introversion	Not sig	Not sig	Not sig
Intuition/Sensing	Not sig	Not sig	Not sig
Thinking/Feeling	Not sig	Not sig	Not sig
Judging/Perceiving	Not sig	Not sig	Not sig
Math Anxiety Rating Scale	*	*	Not sig
MARS Subset	*	*	Not sig
MARS Test Anxiety	*	*	Not sig
Attitude Mult Choice Tests	Not sig	Not sig	Not sig
Attitude CLAST	Not sig	Not sig	Not sig
Attitude Community College	Not sig	Not sig	Not sig
Motiv College	Not sig	N/A	N/A
Motiv Community College	Not sig	N/A	N/A
Parent Attitude Mathematics	Not sig	Not sig	Not sig
Parent Attitude Exams	Not sig	Not sig	Not sig
Parent Attitude College	Not sig	Not sig	Not sig

* $p < .05$

CHAPTER V
SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this study was to compare and contrast the characteristics of students of a community college who performed well on the computations subtest of the CLAST with students who performed poorly or failed this test. Identification of factors likely to be correlated with successful completion of the computations subtest of the CLAST and factors which identify students who are at risk on this test will be useful in designing interventions to enable students to perform well on the CLAST.

Four major research questions comparing these two groups of students were addressed in the study. In answering these questions 14 null hypotheses were tested at the .05 significance level.

The first research question concerned the demographic characteristics of students who performed very well on the computational skills of the CLAST compared with those students who performed poorly on these skills. Two null hypotheses were related to the first research question. The first null hypothesis stated that there are no significant differences in age, sex, race, citizenship, or socioeconomic status between students who performed well and students who performed poorly on the computational skills of the CLAST. The second null hypothesis stated that there are no significant differences in enrollment/employment status, majors, or career plans between students who performed well and students who performed poorly on the computational skills of the CLAST.

The second research question inquired as to whether or not there were significant differences between high and low scoring groups in performance on the other standardized tests. Two null hypotheses were related to the second research question. The third null hypothesis stated that there are no significant differences in placement test scores of the American College Testing (ACT) Program or the Scholastic Aptitude Test (SAT) between students who performed well and students who performed poorly on the computational skills of the CLAST. The fourth null hypothesis stated that there are no significant differences in performance on the reading, writing, or essay subtests of the CLAST between students who performed well and students who performed poorly on the computational skills of the CLAST.

The third research question was posed to examine whether or not there were significant differences in academic preparation between high scoring and low scoring groups. Four null hypotheses were related to the third research question. The fifth null hypothesis stated that there are no significant differences in high school academic preparation between students who performed well and students who performed poorly on the computational skills of the CLAST. The sixth null hypothesis stated that there are no significant differences in college academic preparation between students who performed well and students who performed poorly on the computational skills of the CLAST. The seventh null hypothesis stated that there are no significant differences in college mathematics preparation between students who performed well and students who performed poorly on the computational skills of the CLAST. The eighth null hypothesis stated that there are no significant differences in preparation for the CLAST or perceived difficulty with the CLAST between students who performed well and students who performed poorly on the computational skills of the CLAST.

The fourth research question concerned whether or not there were significant differences in affective characteristics between high scoring and low scoring groups. Six null hypotheses were related to the fourth research question. The ninth null hypothesis stated that there are no significant differences in cognitive styles between students who performed well and students who performed poorly on the computational skills of the CLAST. The 10th null hypothesis stated that there are no significant differences in recall of experiences or role models in mathematics between students who performed well and students who performed poorly on the computational skills of the CLAST. The 11th null hypothesis stated that there are no significant differences in personality type between students who performed well and students who performed poorly on the computational skills of the CLAST. The 12th null hypothesis stated that there are no significant differences in attitudes of students toward mathematics or testing between students who performed well and students who performed poorly on the computational skills of the CLAST. The 13th null hypothesis stated that there are no significant differences in attitudes of students toward college or toward the CLAST between students who performed well and students who performed poorly on the computational skills of the CLAST. The 14th null hypothesis stated that there are no significant differences in perceived attitudes of parents between students who performed well and students who performed poorly on the computational skills of the CLAST.

The 28 students from a particular community college who scored below 275, the minimum score required on the computations subtest of the CLAST by the Florida State Board of Education through July 1985, and an equal number of the highest scoring students (above 359) were selected for study. Data were collected from the office of student records, from questionnaires (Myers-Briggs Type Indicator, Style Delineator by Gregorc, Mathematics Anxiety Rating Scale by Suinn, and seven questions designed to determine field-dependence/independence), and from telephone interviews performed according to a standard format (Appendix C). Of these 56 students, 48 were contacted by telephone or by mail to arrange for interviews and for completion of questionnaires. From these students, 46 questionnaires and 46 interviews were obtained. High school transcripts were available for 43 of the 56 students. All data were analyzed using the Statistical Package for Social Sciences on the IBM 4381 computer. Multivariate analysis of variance, one-way analysis of variance, and chi-square analysis of variance tests were used to establish whether any statistically significant differences existed at the .25 level.

Continuous variables were analyzed by multivariate analysis of variance followed by the multivariate F test and univariate F tests. These variables were (a) age, (b) number of years between high school and CLAST, (c) other CLAST scores, (d) number of college credits earned, (e) community college grade point average, (f) number of mathematics courses at the level of Intermediate Algebra or above, (g) grade point average for all mathematics courses, (h) number of college courses withdrawn/audited, (i) number of mathematics courses withdrawn/audited, (j) high school grade point average, (k) number of semesters of high school mathematics, (l) high school mathematics grade point average, (m) scores from Mathematics Anxiety Rating Scale, (n) scores on Myers-Briggs Type Indicator, and (o) scores on Gregorc Style Indicator.

One-way analysis of variance was performed on the remaining ordered variables. These variables were (a) placement test scores, (b) Finite Mathematics grade, (c) credit hours taken during semester of the CLAST, and (d) hours employed per week during semester of the CLAST.

Discrete variables were compared by chi-square analysis followed by Yates Correction where appropriate. These variables were (a) sex, (b) race, (c) citizenship, (d) family income, (e) parent education, (f) parent occupation, (g) work experience, (h) enrollment in university, (i) major, (j) career plans, (k) high school curriculum, (l) highest high school mathematics course completed, (m) completion of IDS 1189, (n) completion of associate degree, (o) enrollment in developmental mathematics, (p) completion of Finite Mathematics, (q) highest college mathematics course completed, (r) difficulty with CLAST, (s) preparation for CLAST, (t) cognitive style as measured by the Gregorc Style Delineator, (u) field-dependence or independence, (v) childhood experiences and role models, (w) personality type as measured by the Myers-Briggs Type Indicator, (x) general attitude toward CLAST, (y) general attitude toward college, (z) motivation for attending college, and (aa) perceived attitude and general support of parents.

In the following paragraphs, a brief summary of the findings of this study is provided. In answer to the first research question, the high scoring and low scoring groups of students were similar in many ways, but different in others. The mean age for each group was between 24 and 25 years. The average number of years since high school graduation for low scoring students was 6.2 years, one year more than the average for high scoring students, but this difference was not significant. The variables sex, citizenship, and family income resulted in Kendall correlations which were significant at the .05 level, but the chi-square values were not significant at this level. Racially, the groups were significantly different, with the low scoring group consisting of 45% white students, 36% black students, 11% Asian students, and 7% students of other racial designation. The high scoring group by contrast consisted of 93% white students, 0% black students, 7% Asian students, and 0% students of other racial designation. Both mother's educational level and father's educational level were significantly higher for the high scoring group than for the low scoring group.

Comparing enrollment and employment status of students, the low scoring students enrolled in 28% more credit hours, and they worked 23% more hours during the semester of the CLAST. These low scoring students had somewhat less work experience than the high scoring students. In terms of current enrollment and majors, high scoring students were more likely to be currently enrolled and to major in engineering and computer science, which require skill in mathematics. Low scoring students were more likely to major in business, social science, and arts/humanities. The differences for these variables were not significant. Career plans was significantly different at the .05 level, with low scoring students planning careers in business, social science, and arts, while high scoring students planned careers in engineering, education, and computer fields.

In answer to the second research question, students who performed well on the CLAST computational skills also scored significantly higher on all ACT and SAT placement tests and also on the CLAST reading, writing, and essay subtests. Moreover, full range correlations were significant for all testing variables, except the essay subtest.

In answer to the third research question, there were significant differences in academic preparation between students in the high scoring group and those in the low scoring group, especially in terms of high school background and college mathematics preparation. High scoring students earned significantly higher high school total grade point averages, higher mathematics grade point averages, and they enrolled in more semesters of mathematics than did low scoring students. Full range correlations were also significant for these variables. High scoring students enrolled in higher high school mathematics courses, and more frequently completed a college preparatory curriculum, while low scoring students more frequently completed a general curriculum. In comparing overall college performance, except for grade point average, the differences were not significant. Differences between the groups in number of credit hours, number of college-wide withdrawals, and completion of the associate degree were not significant.

In terms of college mathematics preparation, high scoring students enrolled in more semesters of mathematics, at significantly higher levels of mathematics, and they earned significantly higher grades than low scoring students. While low scoring students were more likely to enroll in developmental mathematics courses and Finite Mathematics, the high scoring students who enrolled in Finite Mathematics earned significantly higher grades.

CLAST preparation strategies, including enrollment in IDS 1109 and perceived preparation for the CLAST in general, were not significantly different for the groups. Even the low scoring students stated that they felt adequately prepared for the CLAST. In terms of students' perceived preparation for the computational skills of the CLAST and areas of difficulty with the CLAST, the differences were significant, since low scoring students generally felt unprepared for the computational skills of the CLAST. Within the computations subtest of the CLAST, more low scoring students reported difficulty with the geometric skill area, and more high scoring students reported no difficulty with any of the skill areas.

In answer to the fourth research question concerning affective characteristics of students, significant differences were observed for learning style preferences when assessed numerically, but not categorically. High scoring students preferred the concrete/sequential learning style, while low scoring students preferred the abstract/random style. No significant differences were observed for questions concerning field dependence/independence. Low scoring students expressed significantly more negative memories of mathematics, than high scoring students, but in terms of role models at various stages of life there were no significant differences. No significant differences were observed for personality type. Regarding attitudes towards mathematics and testing, the low scoring students showed significantly higher anxiety toward both mathematics and testing. Finally, no significant differences were observed in attitudes towards multiple choice tests, towards the CLAST, towards the community college, in motivations for attending college, nor in parental attitudes towards mathematics, examinations, and college.

Conclusions

From the findings associated with the first research question, several conclusions were drawn. Since the average age of each group was between 24 and 25 years, it is clear that many students from each group did not attend college immediately after graduation from high school. Many were non-traditional adult learners (Cross, 1971) who had difficulty with academic work. Age was not a significant difference between the groups. This was in contrast with findings of a similar study by Losak, Morris, and Leone (1983) in which lower scoring students from Miami-Dade Community College were significantly older than those in the higher group. However, the observation of more foreign students in the lower group was consistent with findings of Losak et al. (1983). An absence of minority students in the high scoring group and a disproportionate number of minority students, especially black students, in the low scoring group were observed in this study. This observation is consistent with the projection of Losak and Morris (1983) that black students would be the most severely impacted by standardized entrance and exit testing. As to educational levels of parents, those of high scoring students were significantly higher than those of the parents of low scoring students. It was observed that students who have difficulty with the computational skills of the CLAST are more likely to include minority students and first generation college students, while students who perform well on these skills are more likely to be white students of college-educated parents.

The second research question was concerned with the performance of students on other standardized tests, namely the ACT, the SAT, and the other subtests of the CLAST. Belcher (1985b, 1985c), and Losak and Mannchen (1984) found that students who enter the community college with low placement scores have lower passing rates on the CLAST in those areas. A finding of this study was that students who perform poorly on the computational skills of the CLAST have low placement scores, not only in mathematics, but in all of the ACT and the SAT tests, as well as the other subtests of the CLAST. The strong correlation among all standardized tests is evidence that the problem facing low scoring mathematics students may be more than simply lack of mathematics skills. It may also be an indication of the significance of test-taking skills in predicting CLAST performance. What part of the success of the high scoring students may be attributed to their ability to take tests well, and what part of the lack of success of the low scoring students may be attributed to their lack of such skills? Answers to these questions have impact upon the curriculum of the community college and CLAST preparation strategies, as well as the fundamental objectives of the CLAST.

The third research question was concerned with the academic preparation of the students. Significant differences were observed in all high school academic preparation variables, overall college grade point average, and all college mathematics preparation variables. Concerning high school curriculum, high scoring students had more frequently completed a college preparatory curriculum while low scoring students more frequently had completed a general curriculum. These differences are evidence of the inequity that presently exists between college preparatory and general high school curricula (Goodlad, 1984). In college, the general grade point average and grades in mathematics courses were found to be significantly higher for high scoring students than for low scoring students. These findings are consistent with studies by Belcher (1984a, 1985b, 1985c) who demonstrated the significance of grades in MGF 1113 in predicting CLAST performance. Belcher (1985c) also concluded that the more mathematics courses completed, the better the performance on the CLAST. Findings of this study are consistent with those of Losak et al. (1983) who found that a large proportion of the lower scorers earned Cs and Ds and had lower grade point averages than those in the higher group.

In terms of general CLAST preparation, even the low scoring students stated that they felt adequately prepared for the CLAST, an interesting perception considering the actual performance of these students on the other subtests of the CLAST. Low scoring students felt unprepared for the computational skills of the CLAST, and they were apparently preoccupied with the computations subtest of the CLAST as the primary area of difficulty. Within the computations subtest of the CLAST, it was not surprising that significantly more high scoring students reported no difficulty with any of the skill areas. That the geometric skill area was reported as an area of difficulty less frequently by high scoring students was probably a result of exposure to geometric skills as a normal part of coursework in higher mathematics. Also, students who enroll in Finite

Mathematics during the semester of the CLAST are not taught the geometric skills until after the CLAST has been completed. Differences in perceptions of the arithmetic, algebra, logic, and probability/statistics skill areas between the high and low scoring groups were not significant.

The fourth research question was concerned with the affective characteristics of students. In comparing learning style preferences, it was determined that high scoring students expressed a preference for the concrete/sequential while low scoring students preferred the abstract/random style. Perhaps the sequential nature of problem solving in mathematics places those who prefer the random learning style at a disadvantage on the CLAST computations subtest. It is also likely that exposure to additional mathematics courses, especially higher mathematics, develops skill in step-by-step, methodical thinking. If this skill is an acquired one, then there is a need in the community college for learning materials which are designed to assist abstract/random students in developing the sequential skills necessary for success in the computational skills of the CLAST.

Findings concerning memories and attitudes toward mathematics were an indication that low scoring students have more negative memories and higher anxiety towards mathematics. These findings are consistent with those of Betz (1977, 1978) and Daniels and Hewitt (1978), who found a strong inverse relationship between anxiety and performance in mathematics. Dreger and Aiken (1957), Frary and Ling (1983), Rounds and Hendel (1980), and Suinn and Edwards (1982) all pointed to mathematics anxiety associated with poor preparation and poor grades in mathematics. Morris (1981), linked mathematics anxiety and negative memories, saying that mathematics anxiety is a learned response from a negative experience.

No significant differences were observed for personality factors between high and low scoring groups. As with the study by Frary and Ling (1983), who found an absence of relationship between mathematics anxiety and personality variables, there appears to be a lack of relationship between personality factors and CLAST performance.

In conclusion, it appears that the problem of poor CLAST performance is an academic one in which academic preparation and test-taking skills are of greatest significance. The problem is compounded, not by personality factors and lack of role models, but by fear of mathematics resulting from negative experiences followed by general avoidance of mathematics. The following recommendations are based upon the assumption that for many students overcoming these negative experiences and the fear of mathematics is the key to beginning academic preparation.

Recommendations

Recommendations based on the findings and conclusions above must be kept in perspective with ever-changing rules and regulations at the state level. Possible changes in CLAST policies and minimum passing scores, as well as definitions and provisions for teaching developmental mathematics could drastically alter the teaching of mathematics in the community college, as they already have in recent years. Unforeseen changes could affect the strategies recommended here.

First of all, high risk students should be identified upon entry into the community college using the description of students who performed poorly on the computational skills of the CLAST provided by the answer to the first research question of this study. These students may be identified by high school records, placement tests, previous experiences, and attitudes towards mathematics. Strategies--mathematics courses to be taken, CLAST skills to be mastered, test-taking skills to be learned and practiced, and mathematics and test anxiety to be overcome--necessary for successful completion of all community college requirements should be outlined for these students.

Relative to the second research question, the high correlations among all standardized tests (ACT, SAT, and other CLAST subtests) for high and low scoring groups suggest the probable impact of test-taking skills upon student performance and the need for low scoring students to improve these skills. Moreover, additional study should be performed on all students with low placement test scores to determine to what extent students with low entrance test scores have been successful in rising above the minimum standards for the computational skills of the CLAST. This information would be useful in assessing the relative success of the college in adding to the skills of underprepared students and in defending the open-door policy of the community college.

According to the results of the third research question, the lack of successful achievement in mathematics is usually the result of the lack of required skills. Remedial instruction, extra practice, and additional opportunities to learn should be provided for low achieving students. Those services which are already available--practice CLAST, IDS 1109 (CLAST Review), mathematics learning centers, special programs--should be continued, and additional learning materials designed for high risk students should be prepared. These materials should include instruction in the CLAST skills themselves, as well as test-taking skills, and materials to assist students in developing sequential problem solving skills necessary for success in mathematics. Tutoring, with emphasis upon stress reduction and self-confidence should be continued. Support groups, as proposed by Hendel and Davis (1978), should be utilized, especially in reducing mathematics anxiety. Most important is the commitment of students to spend time on homework, both in study groups and individually.

Results of the fourth research question indicate a need for increased awareness among educators, especially mathematics teachers, of the significant differences in attitudes toward mathematics and previous experiences between high achieving and low achieving mathematics students. Low achieving students have significantly higher anxiety and lower self-concepts than high achieving students, as well as a lack of skills necessary for successful achievement. Low achievers who receive inappropriate or critical treatment will fall further and further behind other students. It is important that teachers establish a non-threatening atmosphere in the classroom in which each student is encouraged to reach his or her full potential. Students with negative experiences and low self-confidence will require extra patience, encouragement, and assistance to develop the attitudes and skills necessary for success in the classroom. Success in the classroom, according to this study, translates into success on the CLAST.

APPENDIX A

DATA OUTLINE

I. Personal Data

A. Age

B. Sex

C. Race

D. Socio-economic status

E. Citizenship

F. Parents
   1. Occupation
   2. Educational background

G. Employment
   1. Previous experience
   2. Hours of employment at time of CLAST

H. Personality type (Myers-Briggs Type Indicator)
   1. Introversion/Extraversion
   2. Sensation/Intuition
   3. Thinking/Feeling
   4. Judging/Perceiving

I. Cognitive style
   1. Concrete/Abstract (Gregorc)
   2. Sequential/Random (Gregorc)
   3. Field-dependent/independent (Witkin)

J. Future plans
   1. Major
   2. Transfer plans
   3. Career plans

II. Academic Background

- A. High school
  - 1. Curriculum: academic, vocational, general
  - 2. Career plans while in high school
  - 3. Mathematics courses and grades
  - 4. Overall high school performance
  - 5. Role models, helpers, and hindrances
- B. College
  - 1. Years between high school and the CLAST
  - 2. Placement test scores
  - 3. Mathematics courses and grades including time elapsed between courses and CLAST
  - 4. Overall college performance including number of credits earned, number of withdrawals, and grade point average
  - 5. Role models, helpers, and hindrances

III. CLAST-Related Data

- A. Performance on other parts of CLAST
- B. Specific preparation for CLAST
- C. What helped? What did not?

IV. Attitudes

- A. Childhood and adolescence
  - 1. Positive or negative memories of school (especially mathematics)
  - 2. Role models, helpers, and hindrances
- B. Attitude toward mathematics
- C. Attitude toward tests and examinations
  - 1. Exams in general
  - 2. Standardized/multiple choice tests
- D. Attitude toward college
  - 1. Motivation for attending college
  - 2. Motivation for selecting the community college
- E. Attitude toward CLAST
- F. Parents attitudes
  - 1. Toward mathematics
  - 2. Toward tests and examinations
  - 3. Toward college in general

APPENDIX B

RECORDS DATA SHEET

1. Name: ________________ 2. SS #: ________________

3. Address: ____

4. Telephone: ________________ 5. Score ________

6. CLAST was taken Spring, Summer, Fall, 1985, 1986

7. Date of birth ______.

8. Sex	9. Race	10. Citizenship
1. Male ____	1. White ____	1. USA _____
2. Female ____.	2. Black ____	2. Other _____.
	3. Hispanic ____	
	4. Asian ____	
	5. Other ____.	

11. Hours carried at time of CLAST __________.

12. Date of high school graduation __________.

13. College grade point average ________.

14. Graduated from community college:
    1. Yes ______
    2. No ______.

15. College credits earned __________.

16. Credits of withdrawn, audited, or failed ________.

In 15-19, ACT placement test scores:

15. Eng_____. 16. Math_____. 17. Soc Sci_____.

18. N Sci_____. 19. Composition_____.

In 20-22, SAT placement test scores:

20. Verbal_____. 21. Math_____. 22. Composition_____.

23. High school mathematics courses taken/grade earned:

________________________ ______
________________________ ______
________________________ ______
________________________ ______

24. College mathematics courses taken/grade earned:

________________ ______ ________________ ______
________________ ______ ________________ ______
________________ ______ ________________ ______

25. Term of CLAST preparation courses ________.

In 26-28, other CLAST scores:

26. Reading _____. 27. Writing _____. 28. Essay _____.

APPENDIX C

INTERVIEW DATA SHEET

Date ____________ Time ____________

Any information given in this interview will be held in strictest confidence.

1. Name: ______________. 2. Telephone: ____________.

3. H. S. Curriculum:
   1. College Preparatory ______
   2. Vocational ______________
   3. General ______________.

4. Are you enrolled in school anywhere? ____________.

5. Major? ________. 6. Are you working? ____________.

7. Work experience at or before CLAST? ____________.

8. How many hours did you work at time of CLAST? ____.

9. Did your work schedule interfere with your preparation for the CLAST? ______________________________.

10. What are your career plans? ______________________.

11. Have they changed since high school? ______________.

12. Since the time of CLAST? ________________________.

13. Of the total CLAST, was any part especially difficult for you? ____________________________________.

14. Of the Math part, was anything especially difficult for you? ____.

15. Were you adequately prepared for the CLAST in general? ____.

16. Were you adequately prepared for the Math part? ____.

17. What, if anything, did you do to prepare for the CLAST generally or Math in particular? ______________________________.

18. What helped? ______________________________.

19. What did not? ______________________________.

20. What do you think might have helped, or what could have been done that was not done to help you? ______________________________.

21. Do you have any advice for future students taking the CLAST? ______________________________.

The next few questions are intended to determine the types of people who may have had a positive or negative effect on your life and your attitudes. This may include your parents, relatives, teachers, counsellors, etc. (Please protect the anonymity of these people.)

22. Any role models, helpers, hindrances from childhood and adolescence
    1. Positive ______ ______________________
    2. Neutral ______ ______________________
    3. Negative ______ ______________________.

23. Do you have any positive or negative memories from school (especially mathematics)/comments
    1. Positive ______ ______________________
    2. Neutral ______ ______________________
    3. Negative ______ ______________________.

24. Did you have any role models, helpers, hindrances from high school?
    1. Positive ______ ______________________
    2. Neutral ______ ______________________
    3. Negative ______ ______________________.

25. Did you have any role models, helpers, hindrances from college?
    1. Positive ______ ______________________
    2. Neutral ______ ______________________
    3. Negative ______ ______________________.

26. How do you feel about exams, esp. standardized, multiple choice?
    1. Positive ______ ______________________
    2. Neutral ______ ______________________
    3. Negative ______ ______________________.

27. How do you feel about the CLAST?
    1. Positive ______ ______________________
    2. Neutral ______ ______________________
    3. Negative ______ ______________________.

28. How do you feel about the community college?
    1. Positive ______ ______________________
    2. Neutral ______ ______________________
    3. Negative ______ ______________________.

29. What was your motivation for attending college?
    ______________________________________.

30. What was your motivation for attending the community college? ______________________.

31. Have your parents expressed any attitudes toward mathematics that have influenced you, positively or negatively?
    1. Positive ______ ______________________
    2. Neutral ______ ______________________
    3. Negative ______ ______________________.

32. Have your parents expressed any attitudes toward tests and exams that have influenced you, positively or negatively?
    1 Positive ______ ______________________
    2. Neutral ______ ______________________
    3. Negative ______ ______________________.

33. Have your parents expressed any attitudes toward college that have influenced you, positively or negatively?
    1. Positive ______ ______________________
    2. Neutral ______ ______________________
    3. Negative ______ ______________________.

In 34-40 family information:

34. Father's occup________.

35. Mother's occup_______.

36. Father attended college:
    1. Yes ______
    2. No ______.

37. Mother attended college:
    1. Yes ______
    2. No ______.

38. Father's highest degree

    1. Doctorate _____
    2. Master _____
    3. Bachelor _____
    4. Associate _____
    5. High School _____
    6. Other _____.

39. Mother's highest degree

    1. Doctorate _____
    2. Master _____
    3. Bachelor _____
    4. Associate _____
    5. High School _____
    6. Other _____

40. Family income

    1. $ Under 20,000 _____ (Low)
    2. $20,000 - 39,999 _____ (Middle)
    3. $40,000 and over _____ (High).

APPENDIX D

INSTRUMENT DATA SHEET

1. Name: ________________. 2. SS #: __________.

In 3-6, personality type as measured by Briggs-Myers Type Indicator:

3. E _____ 4. S _____ 5. T _____ 6. J _____
I _____. N _____. F _____. P _____.

In 7-10, cognitive style as measured by Gregorc's Style Delineator:

7. CS _____. 8. AS _____. 9. AR _____. 10. CR _____.

11. Mathematics Anxiety Rating Scale (MARS): ________.

12. MARS Subtest: ______. 13. MARS Test Anxiety: ______.

APPENDIX E

LEARNING STYLE

The following questions are value neutral, and tendency to one is not inherently "better" than another. For each of the following five items, please circle the situation that best describes you.

1. Task oriented: When doing a task,
   a) are you able to concentrate easily on the task at hand, OR
   b) do you find yourself more interested in what is going on around you.

2. Learning environment: Which learning situation do you prefer:
   a) figuring something out on your own, OR
   b) having it explained to you by someone in a lecture.

3. Problem solving: Are you better at solving problems
   a) broadly, applying many different ideas from many different areas to solve a problem, OR
   b) by zeroing in on a specific problem with specific skills to solve it.

4. Work habits: Would you rather work on a project
   a) with a partner, OR
   b) would you prefer to work the project on your own.

5. Thinking skills: Do you think best by
   a) breaking a situation down into its parts and separating the parts from the background, OR
   b) by approaching the situation globally seeing the whole instead of the parts?

6. Test taking: Assuming that you are equally prepared, would you prefer to take
   a) an essay test requiring general answers, OR
   b) a short answer test requiring very specific answers.

7. a) Do you enjoy a challenge of working on problems to which there are definite, agreed upon solutions, OR
   b) Do you prefer the challenge of problems for which there are no clearly right or wrong answers.

APPENDIX F

INITIAL STUDENT LETTER

October 14, 1986

Dear Student:

For the last 15 years I have been a math instructor at ____________ Community College. I am currently doing a study for the college to determine what we can do to assist future students in preparing for the CLAST.

You are one of about fifty students that has been selected for the study. This will consist of a telephone interview and a couple of questionnaires to be completed and returned by mail. In order for the study to be successful, I will need your help.

I will be telephoning you in the near future to give you more details of the study, and to arrange a convenient time for the telephone interview. Your confidentiality will be protected, and no information will be used without your knowledge and consent. I am looking forward to your input and suggestions to help students do better on the CLAST.

Sincerely,

Robert J. Rapalje
Mathematics Department

APPENDIX G

SECOND STUDENT LETTER

November 1, 1986

Dear Student:

Your telephone number as listed in the college computer is not in service. I would like to include you in my study, and in return send you a coupon courtesy of ___(Local Merchants)___. Would you please call me at the office or home, or return the enclosed self-addressed post card with a telephone number so I can call you. Long distance is no problem.

Thank you for your assistance.

Sincerely,

Robert J. Rapalje
Mathematics Department

Home: 555-8163

Office: 555-1450 Ext. 238

APPENDIX H

STUDENT LETTER OF APPRECIATION

November 17, 1986

Dear Student:

Thank you so much for taking time from your busy schedule to complete and return the questionnaire and participate in the telephone interview.

Enclosed please find four certificates from ___(local merchants)___ and also three decals from the community college.

After the study is complete, I will be sending you a summary of the results together with a brief analysis of your personality type and your preferred learning style.

Again thank you for your participation in this study. I wish you well in your studies and career.

Sincerely,

Robert J. Repelje

APPENDIX I

SUPPLEMENTARY FIGURES

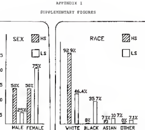

Figure 1. A comparison of Sex and Race Between Students with High Scores and Students with Low Scores on the Computations Subtest of the CLAST. a) Sex, b) Race.

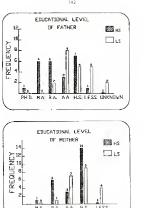

Figure 2. A comparison of Parents' Educational Levels Between Students with High Scores and Students with Low Scores on the Computations Subtest of the CLAST. a) Father's Educational Level; b) Mother's Educational Level.

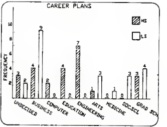

Figure 3. A comparison of Career Plans Between Students with High Scores and Students with Low Scores on the Computations Subtest of the CLAST.

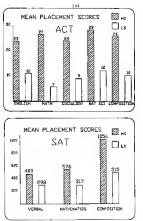

Figure 4. A comparison of Placement Test Scores Between Students with High Scores and Students with Low Scores on the Computations Subtest of the CLAST. a) American Testing Program; b) Scholastic Aptitude Test.

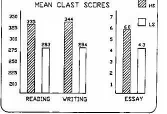

Figure 5. A comparison of Mean CLAST Subtest Scores Between Students with High Scores and Students with Low Scores on the Computations Subtest of the CLAST.

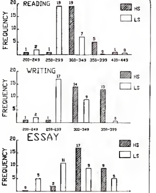

Figure 6. A comparison of CLAST Subtest Distributions Between Students with High Scores and Students with Low Scores on the Computations Subtest of the CLAST. a) Reading Subtest; b) Writing Subtest; c) Essay Subtest.

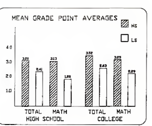

Figure 7. A comparison of Mean Grade Point Average for High School and College Between Students with High Scores and Students with Low Scores on the Computations Subtest of the CLAST.

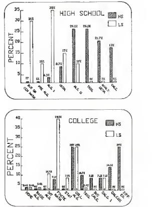

Figure 8. A comparison of Highest Mathematics Course Between Students with High Scores and Students with Low Scores on the Computations Subtest of the CLAST. a) Highest High School Mathematics; b) Highest College Mathematics.

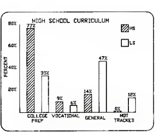

Figure 9. A comparison of High School Curricula Between Students with High Scores and Students with Low Scores on the Computations Subtest of the CLAST.

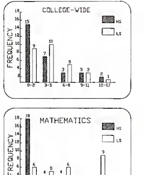

Figure 10. A comparison of Number of Withdrawals and Audits Between Students with High Scores and Students with Low Scores on the Computations Subtest of the CLAST. a) College-wide Withdrawals; b) Withdrawals from Mathematics Courses.

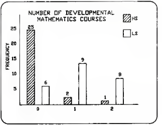

Figure 11. A comparison of Number of Enrollments in Developmental Mathematics Between Students with High Scores and Students with Low Scores on the Computations Subtest of the CLAST.

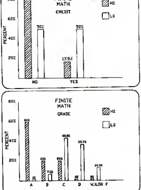

Figure 12. A comparison of Credit and Grade in Finite Mathematics Between Students with High Scores and Students with Low Scores on the Computations Subtest of the CLAST. a) Credit in Finite Mathematics; b) Grade in Finite Mathematics.

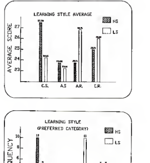

Figure 13. A comparison of Learning Style Between Students with High Scores and Students with Low Scores on the Computations Subtest of the CLAST.
a) Learning Style by Numerical Average;
b) Learning Style by Category of Preference.

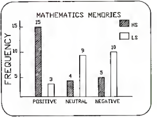

Figure 14. A comparison of Mathematics Memories Between Students with High Scores and Students with Low Scores on the Computations Subtest of the CLAST.

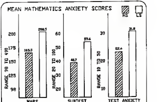

Figure 15. A comparison of Mean Mathematics Anxiety Scores Between Students with High Scores and Students with Low Scores on the Computations Subtest of the CLAST.

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BIOGRAPHICAL SKETCH

Robert J. Rapalje was born in Vineland, New Jersey, December 6, 1945. At the age of 4, he moved to Tavares, Florida, where he resided for 22 years, graduating valedictorian from Tavares High School in 1963. He attended Lake-Sumter Community College, where he graduated magna cum laude with the Associate of Arts degree in 1965. Upon transferring to Florida State University he earned a Bachelor of Science degree in mathematics in 1967. He then completed a Master of Education degree in mathematics education from the University of Florida in 1968.

Rapalje then returned to Lake-Sumter Community College where he was an instructor of mathematics for 2.5 years. In 1970, he enlisted for 6 years in the Florida National Guard. Upon returning from basic training, he became a mathematics instructor at Seminole Community College in 1971, where he remains to the present.

In 1979, Rapalje authored Essential Mathematics, which was used as the text for Seminole's liberal arts mathematics course for 3 years, until increased state requirements altered the curriculum. In 1986, he became coordinator of the mathematics learning center. Through the years, he has written numerous learning supplements from basic algebra through differential equations, including a series of handouts which forms the curriculum for the basic algebra laboratory sessions.

He has taught as an adjunct mathematics instructor for the University of Central Florida, and he has also taught several teachers' inservice workshops for the Seminole County School System. He has made presentations for the Florida Developmental Education Association and for the computations task force of the College Level Academic Skills Project. Kapalje is currently a mathematics instructor and coordinator of the Mathematics Learning Center at Seminole Community College.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Education.

William D. Hedges, Chairman
Professor of Educational
Leadership

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Education.

Elroy J. Bolduc, Jr.
Professor of Instruction and
Curriculum

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Education.

Marcella L. Kysilka
Professor of Instruction and
Curriculum

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Education.

Forrest W Parkay

Forrest W. Parkay
Associate Professor of
Educational Leadership

This dissertation was submitted to the Graduate Faculty of the College of Education and to the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Doctor of Education.

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David C Smith

Dean, College of Education

Dean, Graduate School